LDX-3207B

INSTRUCTION MANUAL

Precision Current Source

ILX Lightwave

A COMMITMENT TO LASER DIODE INSTRUMENTATION

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MODEL LDX-3207B

PRECISION CURRENT SOURCE

INSTRUCTION MANUAL

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4) Description/sketch of what is connected to the ILX Lightwave instrument

5) Description of defect or problem

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Chapter 1

GENERAL INFORMATION

1.1 Introduction

This manual contains operation and maintenance information for the LDX-3207B Precision Current Source and optional Model 1227 GPIB/IEEE-488 Interface. If you want to get started right away, read Chapter 2 which covers Operation first.

1.2 Product Overview

The LDX-3207B is a precision current source optimized for driving laser diodes and LEDs with an output range of 0 to 200 mA and a compliance voltage which is adjustable from about 2 to 5 volts. Multiple built-in protection features ensure that the supply output is transient free and bounded under all conditions. The output level of the LDX-3207B is controllable in three ways: (1) manually via a 10-turn precision control knob, (2) through an analog voltage control/modulation port, and (3) remotely via the optional model 1227 GPIB/IEEE-488 Interface. The three selectable modes of operation allow versatility in use: (1) constant current, high bandwidth mode; (2) constant current, low bandwidth mode - for added transient protection and lower noise; and (3) constant power, low bandwidth mode - for driving a laser diode to ensure constant light output.

Features of the LDX-3207B include:

* Intuitive front panel layout
* Highly visible green LED display
* Display resolution of 0.1 mA
* Fully independent, precision current limit control
* 3 selectable modes of operation, including constant light output mode
* Adjustable compliance voltage
* Adjustable feedback gain, for photodiode feedback
* DC to 100 KHz voltage control/modulation port
* Safe output off/on switch
* Audible and visual fault condition indicators
* Optional GPIB/IEEE-488 Interface for remote programming

1.3 Available Options and Accessories

Options and accessories available for the LDX-3207B include the following:

DESCRIPTION	MODEL NUMBER
GPIB/IEEE-488 Interface	1227
Rack mount, 1/2 width filler panel kit for mounting one instrument	124
Dual rack mounting kit for mounting two instruments side by side	122

The 1227 interface permits GPIB bus control of the LDX-3207B making possible many automated test and measurement applications. For more information on this interface option see Chapter 3 on Remote Programming.

The LDX-3207B enclosure is a half-width, rack mountable module designed to be rack mounted either by itself or interlocked with other ILX Lightwave, half-width instruments. The hardware accessories, listed above, make rack mounting and interlocking of these enclosure modules possible.

1.4 Specifications

OUTPUT

OUTPUT CURRENT RANGE:	0 to 200 mA, floating
COMPLIANCE VOLTAGE:	2 to >5 volts, adjustable
TEMPERATURE COEFFICIENT:	<100 ppm/^{o}C ambient
NOISE AND RIPPLE (@ 100 mA output):	<11 uA, rms (HIGH BW mode) <4 uA, rms (LOW BW modes)

DISPLAY

TYPE:	4-digit LED display	
	Output	Photodiode
MAXIMUM READING:	200.0 mA	2.000 mA
RESOLUTION:	0.1 mA	0.001 mA
ACCURACY (25 ^{o}C):	$\pm$0.2 mA	$\pm$0.005 mA
TEMPERATURE COEFFICIENT:	<100 ppm/^{o}C	<100 ppm/^{o}C

CURRENT LIMIT

RANGE:	0 to 200 mA
ACCURACY:	±2.0 mA, independent of output compliance voltage

Current limit adjustment does not interfere with normal output operation (a dummy load is not required). Current limit setting takes precedence in all modes of operation.

COMPLIANCE VOLTAGE LIMIT

RANGE:	2 to >5 V, rear panel adjustable

MODULATION/VOLTAGE CONTROL

INPUT:	Differential input
TRANSFER FUNCTION:	100 mA/V
TRANSFER FUNCTION ERROR:	<1%
BANDWIDTH (3 db, I-out = 50 mA P-P):	DC to 100 KHz (In CONST I, HIGH Bandwidth mode)

IEEE-488 BUS IMPLEMENTATION (with optional Model 1227 interface)

GENERAL:	Implements talker/listen functions
INTERFACE MESSAGES:	MLA, MTA, UNL, UNT, ATN, REN, DCL, LLO, GTL, SDC

DEVICE DEPENDENT COMMAND STRUCTURE:

Command	Function
Bn	Beeper control commands
Cnnn.nnn	Set output current to nnn.nnn mA
CR	Get current values
Dn	Select display
Fn	Operating mode selection
Gn	Get commands: error status and SRQ mask
Mn	Modulation port enable/disable
Nnn	Numeric values for setting SRQ mask
On	Switch output: 0 = off, 1 = on
P10	Used with Nn to set SRQ mask
Wn	Terminator commands
Yn	Control mode selection
Z0	Self test
*	Device clear

ISOLATION:	Instrument is optically isolated from the IEEE-488 bus
CONTROL RESOLUTION:	12 bits (0.05 mA)
CONTROL ACCURACY:	±0.1 mA

GENERAL

POWER REQUIREMENTS:	Nominal Voltage	Range (jumper selectable)
	100 VAC	90-110 VAC
	120 VAC	108-132 VAC
	220 VAC	198-242 VAC
	240 VAC	216-264 VAC

at 50-60 Hz

SIZE:	88 mm x 21 mm x 269 mm (3.46" x 8.36" x 10.6")
TEMPERATURE RANGE:	0 to 50°C operating, -40 to 70°C storage
WARM-UP:	1 hour to rated accuracy
CONNECTORS:	Output 9-pin D-connector and binding posts to laser diode (isolated from chassis ground), chassis ground binding post, modulation input BNC (differential input)

1.5 Your Comments

Our goal is to make the best laser diode instrumentation available anywhere. To achieve this, we need your ideas and comments on ways we can improve our products. We invite you to contact us at any time with your suggestions. (See the third cover page.)

Chapter 2

OPERATION

2.1 Introduction

This chapter describes how to install, adjust, and operate the LDX-3207B. It is divided into four sections covering installation, familiarization and adjustment of the LDX-3207B, warm-up and environmental considerations, and normal operating procedures.

2.2 Installation

Installation procedures and considerations are covered in Sections 2.2.1 - 2.2.3.

2.2.1 AC Power Considerations

The LDX-3207B can be configured to operate at nominal line voltages of 100, 120, 220, or 240 VAC. Normally, this is done at the factory and need not be changed before operating the instrument. However, check to be sure that the voltage printed on the rear panel of the instrument matches the power-line voltage in your area. Refer to Chapter 5 (Maintenance) if it is necessary to reconfigure the input voltage range.

WARNING

To avoid electrical shock hazard, connect the instrument to properly earth-grounded, 3-prong receptacles only. Failure to observe this precaution can result in severe injury or death.

NOTE - For Incoming Inspection of this Product

This product contains transient protection devices (MOVs) near the AC power input. If this product is tested for reliability by placing high voltage surges on the AC input, these solid-state MOV devices may cause the test to indicate failure, when in fact the unit is reliable. These MOV devices should be removed prior to any such testing (see Diagram 7.3).

2.2.2 Tilt-Foot Adjustment

The LDX-3207B is supplied with special, extendable front legs. The front of the instrument can be tilted up for better viewing by rotating the legs downward until they snap into the "down and locked" position.

2.2.3 Rack Mounting

The LDX-3207B may be rack mounted singly by installing a rack mount flange on one side of the enclosure and a 1/2 width filler panel on the other side. Alternately, two half-width enclosures can be interlocked side-by-side and then rack mounted as a unit by using a pair of rack mount flanges. Detailed mounting instructions are supplied with all rack mount accessory kits. Refer to Section 1.3 for applicable rack mount accessory part numbers.

2.3 LDX-3207B Familiarization

The following Sections are given to familiarize the user with the features of the LDX-3207B. Sections 2.3.1 - 2.3.11 deal with features found on the front panel, and Sections 2.3.12 - 2.3.17 deal with features found on the rear panel.

2.3.1 Front Panel

Figure 2.1 shows the layout of features on the front panel. Generally, you will find the LDX-3207B controls and features to be simple and intuitively easy to use. However, the following Sections provide descriptions of each front panel feature.

2.3.2 Power-Up Sequence

With the LDX-3207B properly connected to an AC power source, turning the switch key and pressing the POWER OFF/ON switch causes the unit to initiate its power-up sequence. During this sequence, the audible fault indicator (beeper) will sound and all displays will light up. At this time the LDX-3207B will be conducting its self test. However, during this period the output terminals are unconditionally shorted and the OUTPUT OFF/ON switch is inhibited for several seconds, preventing current from leaving the output terminals. After about two seconds, the display should read 0.0 mA.

If you hold the GPIB REMOTE/LOCAL switch in when you power-up the LDX-3207B, the beeper will be disabled.

At power-up the following default settings are made:

Output current (OUTPUT) is OFF.

The modulation/voltage (MOD) port is enabled.

The beeper (audible fault indicator) is enabled.

The output voltage limit indicator (VOLTAGE LIMIT) is cleared.

The SRQ mask is (cleared) set to 00.

2.3.3 Operating MODE Selection

There are 3 modes of operation which can be selected from the MODE switch on the front panel.

1) CONST I, LOW BW (constant current, low bandwidth) is the normal operating mode. A voltage feedback path and a current feedback path are used to maintain a constant output current. This mode prevents the supply from rising rapidly if a momentary break-and-remake occurs in connections to laser diodes. Figure 4.4 is a block diagram of CONST I, LOW BW operating mode.

2) CONST P, LOW BW (constant power, low bandwidth) mode is used when it is desired to control the light-power of the laser diode. In this mode, feedback from the laser's photodiode is used to control the output of the LDX-3207B. The photodiode feedback gain is adjusted by the user (see Section 2.3.17). As in CONST I, LOW BW mode, the supply will not rise rapidly if a momentary break-and-remake occurs at the output. Figure 4.3 is a block diagram of CONST P, LOW BW mode.

3) CONST I, HIGH BW (constant current, high bandwidth) mode is similar to CONST I, LOW BW mode. However, the output bandwidth is greater and the response faster in the HIGH BW mode. See Figure 4.2 for the block diagram for CONST I, HIGH BW operation.

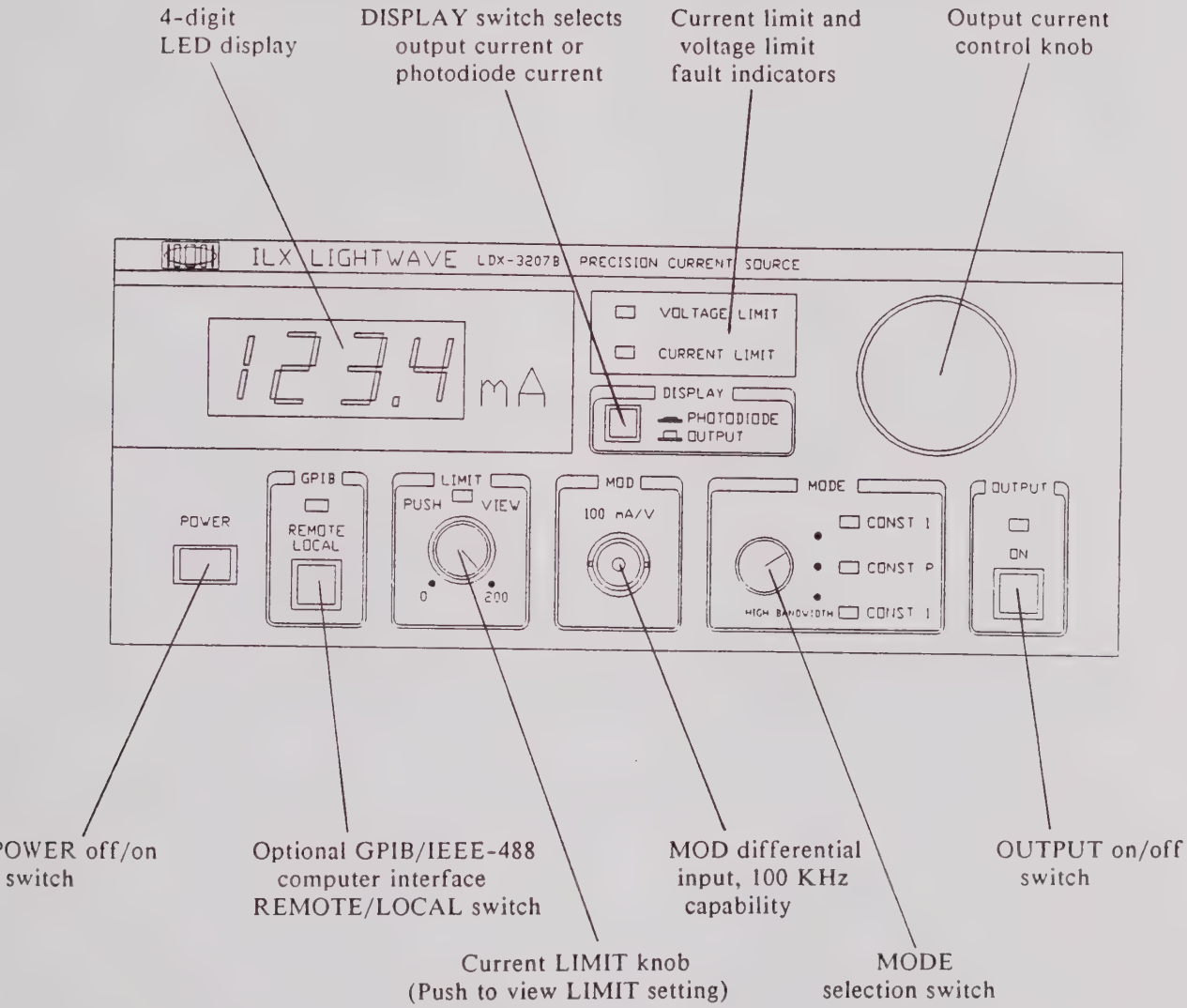


Figure 2.1 LDX-3207B Front Panel Layout

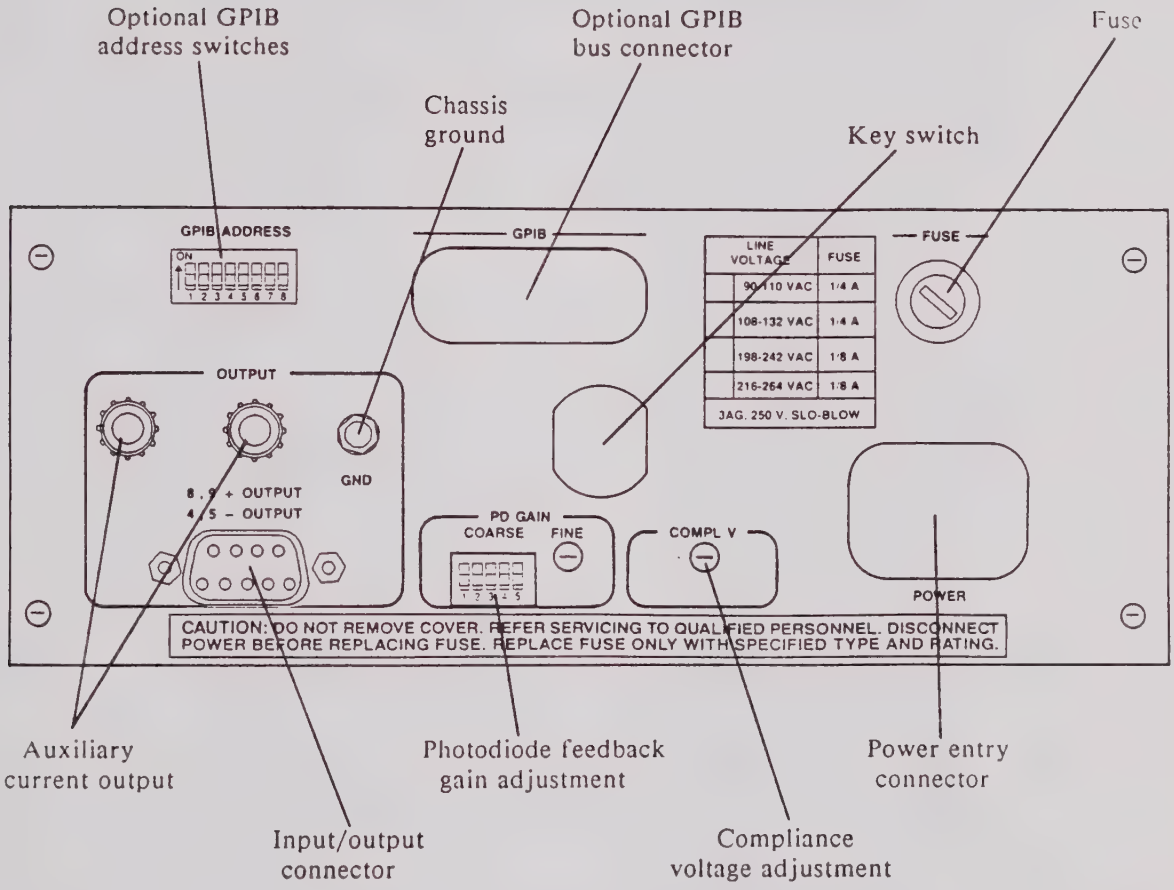


Figure 2.2 LDX-3207B Rear Panel Layout

2.3.4 Current LIMIT Adjustment

The front panel LIMIT control setting determines the maximum output current for all modes of operation. This current limit is set by rotating the LIMIT knob to the desired value. The current LIMIT setting can be estimated by observing the position of the knob indicator line relative to the 0 and 200 mA markings, or determined precisely by momentarily depressing the LIMIT knob. Once the LIMIT knob has been depressed, the display will read the current limit setting for about 5 seconds. During this 5 second interval the LIMIT indicator light remains on.

The current limit setting is independent of the voltage drop of the device connected to the output of the LDX-3207B, and therefore no dummy load is required for precise adjustment of the current limit. Furthermore, since the current limit circuitry is fully independent of the main current control, the current limit can be adjusted safely even while the output is active.

2.3.5 Output Current Adjustment

Primary output current control is provided by the large knob located on the front panel of the LDX-3207B. This knob is connected to a precision 10-turn potentiometer and can easily be used to achieve a setting resolution of 0.05 mA (or 0.02 mA with some care). Depending on whether the LDX-3207B is in LOCAL or REMOTE mode, the output current is also effected by any control voltage applied to the MOD input connector or by commands sent to the optional GPIB/IEEE-488 interface (when installed). Under all modes of operation, the output current is unconditionally limited to the value set by the LIMIT adjustment.

Local Mode - When initially turned on, the LDX-3207B is in LOCAL mode. In this operating mode, the output current is determined by the setting of the main output current adjustment knob and any control signal applied to the MOD input connector. The control level generated by the control knob is summed with the control signal applied to the MOD input. In effect, the control knob acts as a DC bias (offset) adjustment to the signal applied to the MOD input.

Remote Mode - When the model 1227 GPIB/IEEE-488 interface is installed, the LDX-3207B may be operated in REMOTE mode. This mode of operation is activated in response to commands sent to the LDX-3207B via the interface. Once in REMOTE mode, the output current level is determined by appropriate commands sent over the GPIB/IEEE-488 bus. For example, the command "C50.01" will cause the output of the LDX-3207B to go to 50.01 mA (to within the control accuracy of the interface). In this mode of operation the main current adjustment knob is disabled. The LDX-3207B may be returned to LOCAL mode by momentarily pressing the LOCAL button. For more information on the REMOTE mode of operation refer to Chapter 3.

2.3.6 OUTPUT OFF/ON Switch

The OUTPUT OFF/ON switch is located in the bottom right corner of the front panel. It is used to turn the output of the LDX-3207B off and on. When the output is active, the LED indicator (just above the switch) is lit to indicate that current is flowing from the positive to negative terminals. The OFF/ON switch has a toggling action: if the output is off, pressing it will cause the output to come on, and vice versa.

When the output is off (LED unlit), a low impedance shunt is active across the output terminals. In this state it is safe to connect or remove sensitive devices from the LDX-3207B, even though the power supply itself is on. Turning the output on initiates a slow turn-on sequence that takes a few seconds to complete. During this period, the impedance of the internal shunt slowly increases, diverting current through the output terminals.

When the LDX-3207B is first turned on, the OFF/ON switch is inhibited for several seconds. This forces the internal, low impedance shunt to remain active across the output terminals until the LDX-3207B circuits are stabilized. Additionally, there are three other conditions that will automatically cause the output to reset to the off state:

> Power Drop-outs - AC line power drop-outs lasting more than about 10 msec will trigger an internal power monitor and cause the output to switch unconditionally to the OFF state. This sequence is also initiated when the LDX-3207B is switched off or unplugged.
>
> Open Circuit - If the compliance voltage of the externally connected circuit exceeds the set compliance voltage (set by trimmer pot adjustment on the rear panel), the output is switched to the OFF state and the VOLTAGE LIMIT indicator is activated. Most commonly this occurs when the OUTPUT OFF/ON switch is pressed without a load attached. (See Section 2.14).
>
> Interlock - If the Interlock connections are opened, the LDX-3207B will be reset to the off state.

If any of these conditions occur, the output may be turned on (LED lit) again by simply pressing the front panel OUTPUT OFF/ON switch, once the circuits have been restored.

2.3.7 Modulation/Analog Control Port

The modulation/analog control port provides a means of modulating the output current of the LDX-3207B with a 3 db bandwidth of DC through 100 KHz (in CONST I, HIGH BW mode). Input connection is provided by an isolated BNC connector designated MOD on the front panel. This connector provides a true differential input, and need not use the same ground as the output terminals. The only restriction is that the control signal applied to the MOD connector should be within approximately 10 volts of the output terminals.

In LOW BW modes, the bandwidth of the external modulation is decreased to about 10 Hz. Higher frequency components in the modulation will result in a mixture of optical light-power modulation and current modulation in the laser.

Modulation/Voltage Control Port (MOD Input)
(in CONST I, HIGH BW mode)

TRANSFER FUNCTION:	100 mA/Volt
CONTROL BANDWIDTH (3 db):	100 KHz
INPUT IMPEDANCE:	1000 ohms
INPUT POLARITY:	Center pin - POS Shell - NEG

Any control signal applied to the MOD input is summed with the control signal due to the main current control knob setting. The transfer function of the modulation/voltage control input is +100 mA/Volt with respect to the shell. Thus, with the main current control knob set to 100 mA, and a 0.5 volt input present at the MOD input, the resulting current would be 150 mA.

Normally, the MOD port is always enabled. The MOD input may be disabled only when the LDX-3207B is in REMOTE mode and the "M0" command is sent to the optional 1227/GPIB interface. However, if the MOD port is disabled in REMOTE mode, the MOD port will remain disabled upon returning to LOCAL mode, unless it is first enabled again while in REMOTE mode.

2.3.8 Fault Indicators

The LDX-3207B has two visual front panel fault indicators, VOLTAGE LIMIT and CURRENT LIMIT, and an audible tone (beeper) that are used to identify open circuit and current limit conditions.

VOLTAGE LIMIT - indicates that the compliance voltage required at the LDX-3207B output terminals has exceeded the set compliance voltage value. Most commonly this happens when there is no load attached to the output, or when the load becomes disconnected when the output is active. When a VOLTAGE LIMIT condition occurs, the LDX-3207B output is automatically turned off, the VOLTAGE LIMIT indicator latches on, and a tone sounds for approximately 1 second. The VOLTAGE LIMIT indicator will remain on until the output is turned on again, either manually or via the GPIB/IEEE-488 interface.

CURRENT LIMIT - indicates that LDX-3207B output is being limited to the setting of the front panel LIMIT knob. When a LIMIT condition occurs, the CURRENT LIMIT indicator is lit and a tone is repeatedly sounded. Due to the unique design of the LDX-3207B, the CURRENT LIMIT indicators are operative even while the output is off.

If the LDX-3207B is repetitively driven into the current limit mode by a time varying signal applied to the MOD input, the CURRENT LIMIT indicator will light and a tone will sound. The tone may be continuous or intermittent depending on the frequency of the modulation signal. With the 1227 interface installed, the status of both the VOLTAGE LIMIT and CURRENT LIMIT indicators may be read back over the GPIB/IEEE-488 bus. For more information on this feature see Chapter 3.

2.3.9 GPIB REMOTE/LOCAL Switch

The GPIB REMOTE/LOCAL switch is used to return the LDX-3207B to local control after it has been put in REMOTE mode via the GPIB/IEEE-488 bus. In REMOTE mode, the main current control knob is disabled and the LDX-3207B output may be controlled only via the GPIB/IEEE-488 bus. This control mode is available only when the optional model 1227 GPIB/IEEE-488 interface is installed. For more information see Chapter 3.

If the GPIB REMOTE/LOCAL switch is pressed when in LOCAL mode, the address number of the GPIB interface will be displayed for about 2 seconds.

2.3.10 DISPLAY Switch

The display normally indicates the output current. The maximum reading of the display is 200.0 mA, with a resolution of 0.1 mA. When the DISPLAY switch is in the PHOTODIODE position (in), the photodiode feedback current will be displayed. In this configuration the display will have a resolution of 0.001 mA, the decimal point will move to the left, and a maximum reading of 2.000 mA can be displayed.

2.3.11 Beeper Off/On Selection

The audible fault indicator (beeper) is automatically turned on during the power-on sequence. If the beeper is not desired, it may be defeated by pressing the GPIB REMOTE/LOCAL switch simultaneously with the AC POWER switch (ON) when powering up the LDX-3207B.

The beeper may also be defeated by the B0 command when the optional GPIB/IEEE-488 interface is used. See Section 3.6.1 for REMOTE beeper control.

2.3.12 Rear Panel

The rear panel contains the AC power input connector, fuse holder, serial number sticker, 9-pin D-sub connector, banana-type OUTPUT posts, bare metal banana-type chassis GND post, (photodiode) PD GAIN controls, and COMPL V (compliance voltage) control. When the optional model 1227 GPIB/IEEE-488 interface is installed, the rear panel additionally contains the standard GPIB/IEEE-488 bus connector and address selector switch. Output current is available at the 9-pin D-connector, CON6. CON6 is also utilized for

the photodiode input signal. CON6 also contains an interlock which will disable the current output unless defeated. See Section 2.5.2 for detailed information. For information on the fuse replacement, see Section 5.3. For information regarding programming in preparation for using the GPIB/IEEE-488 interface, see Section 3.3.

The key switch is located on the rear panel.

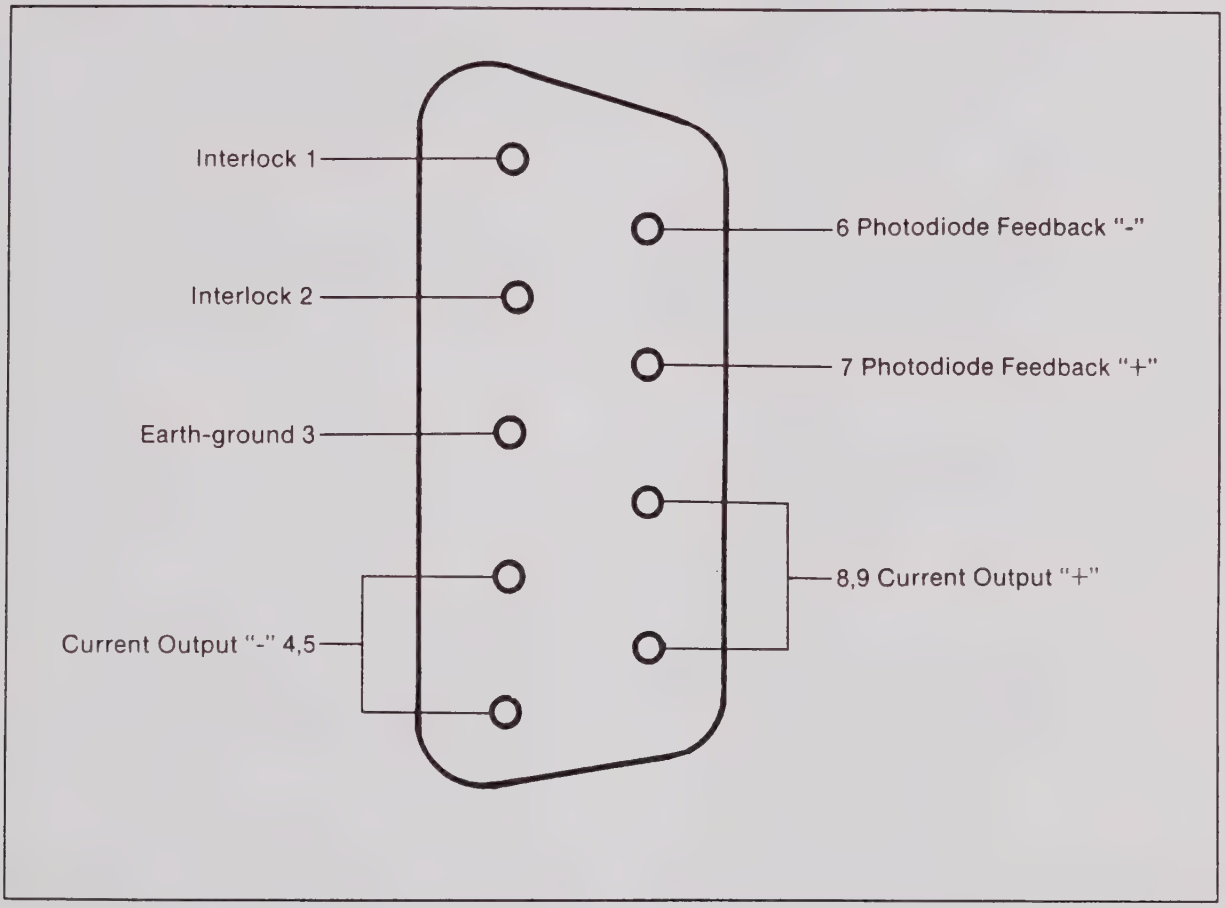


Figure 2.3 D-Connector Pinout (CON6) Rear View

NOTE - Whenever external connections are made to the output at pins 4 and 5, and 8 and 9, these connector leads must be jumpered as shown above to ensure the greatest laser diode safety.

2.3.13 Output Connectors

The main current output is via the 9-pin D-connector (CON6). This connector is recommended for use with laser diodes, since it is not prone to accidental circuit break-and-remakes which can damage laser diodes.

> **IMPORTANT**
>
> **It has been our experience that laser diode damage during testing occurs most often as a result of an accidental circuit break-and-remake condition. Therefore, secure wiring to your laser diode is important.**

The rear panel also has current output supplied by two standard binding posts on 0.75 inch centers. Current flows out of the red connector and returns via the black connector. These output connectors are fully floating with respect to the chassis ground. We do not recommend using the binding posts for connecting to laser diodes.

2.3.14 Chassis GND Connector

Chassis ground is available via the bare metal binding post marked GND on the rear panel.

2.3.15 GPIB/IEEE-488 ADDRESS Switches

When the model 1227 GPIB/IEEE-488 interface option is installed, the address is selectable via the ADDRESS DIP switches on the rear panel (see Figure 3.1). When multiple devices are on the bus, each device must have a unique address (see Section 3.3).

2.3.16 Compliance Voltage Adjustment

The COMPL V compliance voltage control pot allows the user to lower the compliance voltage from >5 V at the maximum setting (CW), to several volts at the minimum setting (CCW). The COMPL V control can be reached by inserting a small flat blade screwdriver into the slot on the rear panel marked COMPL V.

2.3.17 Photodiode Feedback PD GAIN Adjustment

When CONST P, LOW BW mode is selected, the laser's photodiode current may be fed back to control the LDX-3207B's output via the 9-pin D-connector (see Figure 2.3). This feedback maintains a constant light output of the laser when the gain is set properlyThe photodiode feedback PD GAIN is set via the COARSE DIP switch and the FINE pot on the rear panel (see Figure 2.4). The

FINE GAIN adjustment can be reached by inserting a small flat blade screwdriver into the slot on the rear panel marked FINE.

After the feedback element has been installed, the gain of the constant power input circuit must be adjusted so that a full scale setting of the output current, via the control knob or GPIB, will produce the correct photodiode feedback current (and thus the correct laser diode light-power level). Follow these steps:

1. Select CONST P mode, turn the front panel Output Current Control Knob fully counter-clockwise for minimum current, and turn the OUTPUT switch off.

2. Determine the maximum current to be delivered to the laser diode for this operation. **Make sure this is less than the absolute maximum rating for the laser diode.** Set the current LIMIT knob to this value. To display the current LIMIT setting, push the LIMIT knob.

3. Set the COARSE PD GAIN switches so that all 5 switches are in the off position (down), and set the FINE pot to its fully clockwise (CW) position. This initially maximizes the PD gain and minimizes the output current to the laser diode.

4. Turn the Output Current Control Knob fully clockwise to allow the output current to go to the LIMIT value, and turn the OUTPUT on. Slowly turn the FINE PD GAIN pot counter-clockwise (CCW) until the current limit beeper starts beeping. If the FINE pot is turned fully counter-clockwise and the current limit is not reached, continue to Step 5.

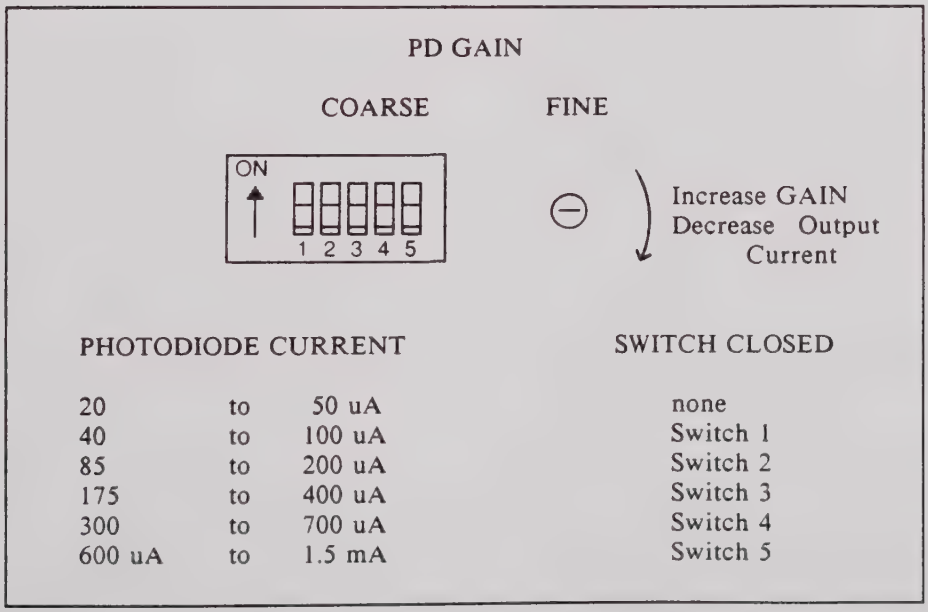


Figure 2.4 Photodiode COARSE GAIN Settings

5. Return the FINE PD GAIN pot to its fully clockwise (CW) position. Set COARSE switch 1 to the on position. Then, slowly turn the FINE pot counter-clockwise until the current limit is reached (and the beeper starts). If the limit is not reached, continue with Step 6.

6. Return the FINE control to the fully clockwise position (CW), and set all the COARSE switches to their off positions. Then, set the next higher COARSE switch to the on postition and adjust the FINE control as before until the current limit is just reached. If the current limit is not reached, repeat Step 6 using the next higher COARSE switch setting.

After this adjustment procedure, the front panel display will continue to display the actual output current or photodiode feedback current, depending on the position of the DISPLAY switch. The optical light-power, however, will now be proportional to the setting of the front panel knob (or GPIB) setting. That is, maximum optical light-power can be selected by setting the output to 200 mA. This can be done by turning the front panel knob fully clockwise or by sending a "C200" command over the GPIB. One half of maximum optical light-power can be selected by a setting of 100 mA.

NOTE - The PHOTODIODE CURRENT ranges shown in Figure 2.4 are approximations of the photodiode current required for maximum light output with each COARSE switch setting. To prevent an accidental over-current to the laser diode, set the current LIMIT before adjusting the PD GAIN, and follow the above steps. At most, one COARSE switch should be on (up).

2.4 Warm-up and Environmental Considerations

The LDX-3207B should be operated at an ambient temperature between 0 and 50°C. Storage temperatures should be in the range -40 to 70°C. In order to achieve rated accuracy, the LDX-3207B should be allowed to warm up for 1 hour before use.

2.5 Operating Instructions

Sections 2.5.1 - 2.5.5 deal with device connections and general operating procedure.

2.5.1 Connecting to Your Device

When connecting laser diodes and other sensitive devices to the LDX-3207B, we recommend that the LDX-3207B be powered-up and the OUTPUT be off (LED unlit). In this condition a low impedance shunt is active across the output terminals. When disconnecting devices, it is only necessary to turn the OUTPUT off.

Pins 4 and 5 of CON6 are the negative output, and pins 8 and 9 are the positive output current connections (see Figure 2.3). These pins are jumpered to provide greater contact area for the output connections. This is done to reduce the risk of an open output connection due to a loose connector. Thus, the output is made safer for laser diodes.

> **NOTE - Whenever external connections are made to the output at pins 4 and 5, and 8 and 9, these connector leads must be jumpered as shown in Figure 2.3 to ensure the greatest laser diode safety.**

We also recommend the use of the 9-pin D-connector (CON6), rather than the binding posts, whenever possible. The 9-pin connector is safer to use.

2.5.2 System Interlock Connections

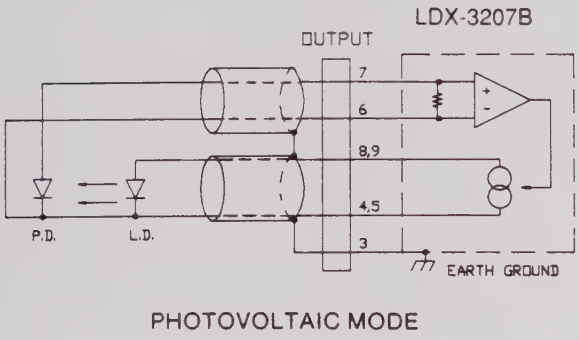
When the LDX-3207B is part of a system, an interlock is incorporated at the rear panel 9-pin D-connector (CON6) and is defeated by internal wiring located inside the hood of the supplied interconnect cable. In standard units the interlock is not internally defeated. If the interlock feature is not desired, please contact ILX Lightwave for information.

When the interlock function is to be used, a switch must be wired across pins 1 and 2 of CON6. To do this, open the cable hood located at the end which connects to CON6. The connections are made across pins 1 and 2 of the cable connector. When the desired wiring has been installed, replace the hood on the cable. The switch must be electrically isolated from all other circuits, including earth ground. Refer to Figure 2.3 for more information.

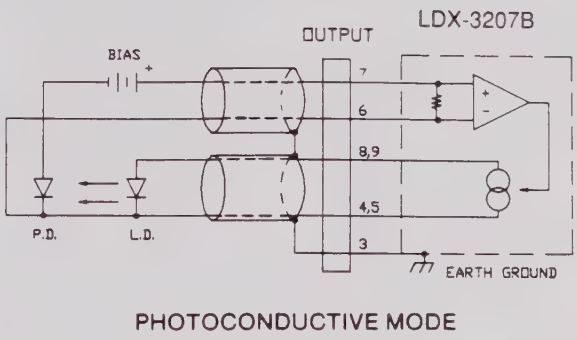
2.5.3 Laser Diode Connections and Shielding

> **IMPORTANT**
>
> **Before connecting the laser diode to the LDX-3207B, be sure that the front panel OUTPUT switch is in the OFF position (LED unlit). Before turning ON the OUTPUT, be sure that the current LIMIT has been correctly set.**

The LDX-3207B output is available through the 9-pin rear panel connector (see Figure 2.3). The LDX-3207B sources current through pins 8 and 9 to the laser anode (+) and returns current from cathode (-) through pins 4 and 5. Pins 8 and 9 are internally jumpered, and pins 4 and 5 are also connected together internally; these pins are used in pairs to ensure integrity in the connection to external laser diodes.

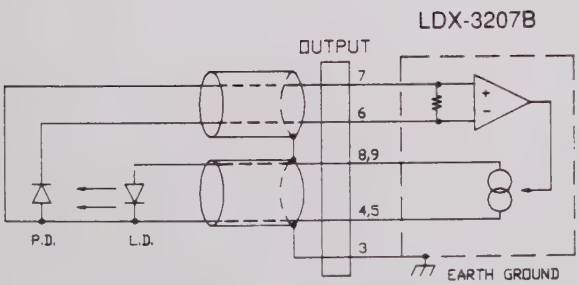


PHOTOVOLTAIC MODE

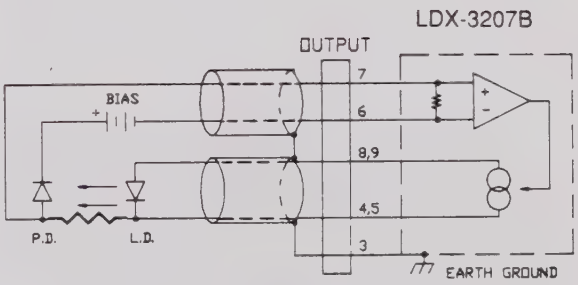


PHOTOCONDUCTIVE MODE

Figure 2.5A Common Laser Cathode - Photodiode Cathode

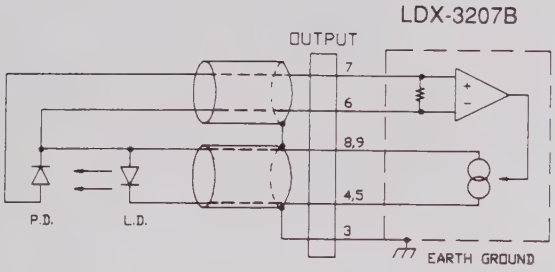


PHOTOVOLTAIC MODE

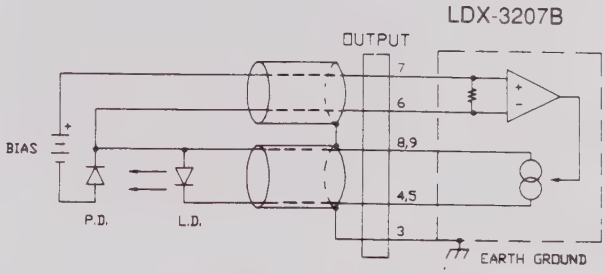


PHOTOCONDUCTIVE MODE

Figure 2.5B Common Laser Cathode - Photodiode Anode

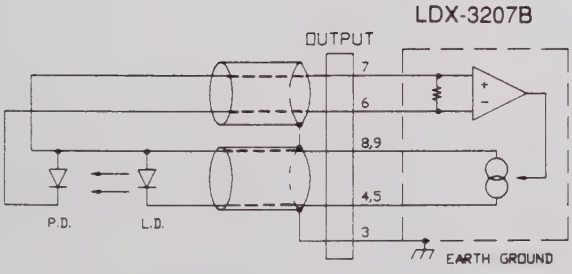


PHOTOVOLTAIC MODE

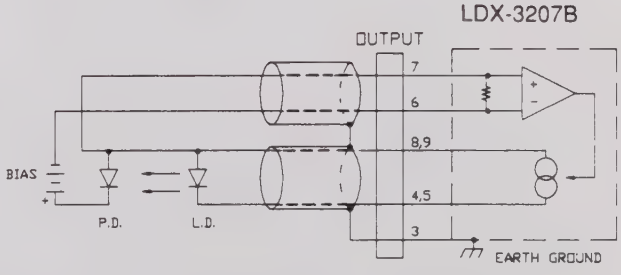


PHOTOCONDUCTIVE MODE

Figure 2.5C Common Laser Anode - Photodiode Cathode



PHOTOVOLTAIC MODE



PHOTOCONDUCTIVE MODE

Figure 2.5D Common Laser Anode - Photodiode Anode

IMPORTANT

The cable connections to the laser must be secure enough that they won't open-circuit, should they be jostled or bumped. Should an open circuit occur during laser operation, the OUTPUT will be turned off (LED unlit) automatically.

Experience indicates that should an open circuit occur during laser operation (while the OUTPUT is ON and CONST I, HIGH BW mode is selected), the laser may be damaged by a momentary circuit break-and-remake before the final circuit break. Therefore, secure cabling in HIGH BW mode is very important.

The use of either LOW BW mode provides excellent protection against laser damage due to momentary circuit break-and-remake conditions.

It is recommended that the connections to the LDX-3207B output be made using twisted wire pairs with an earth-grounded shield (see Figures 2.5 A - D). The output terminals of the LDX-3207B are left floating relative to earth ground to suppress AC power-on/power-off transients that may occur through an earth-ground path. If the output circuit is earth-grounded at some point (such as through the laser package and mount), the user must be careful to avoid multiple earth grounds in the circuit. Multiple earth grounds may provide circuit paths that induce spurious currents in the photodiode feedback circuit and output leads.

2.5.4 Photodiode Feedback Connections

The 9-pin D-connector (CON6) on the rear panel contains the current supply output and earth ground. The photodiode signal is input at the connector at pins 6 and 7 (see Figure 2.3).

Many laser diode modules contain an internal photodiode that monitors the back-facet emission of the laser. Usually, this photodiode is internally connected to either the laser anode or cathode. Figures 2.5A - 2.5D show the recommended connections and shielding for the various configurations of laser diode modules and photodiode feedback schemes.

If the feedback photodiode reverse-biasing supply shown in these figures is used, the external biasing voltage must be supplied by the user. You must locate this supply where it won't cause the common mode voltage of the feedback inputs to exceed the specified maximum of $\pm$10 V, relative to the "-" current output (CON6, pins 4, 5). Noise from this biasing supply may contribute to the output noise levels; therefore, a battery with shielded connections is recommended.

If a feedback photodiode is used, which is electrically isolated from the laser, the feedback circuit must be resistively "tied" at some point to the output circuit. A large resistance of about 1 Mohm, connected from the laser cathode to the photodiode anode, may be used in place of the direct connection (see Figure 2.5B). This is done to keep the feedback inputs within the specified maximum +/-10 volt common mode voltage, relative to the "-" laser current output terminal. If possible, use the circuit of Figure 2.5B.

2.5.5 Grounding Considerations

The outputs of the LDX-3207B are isolated from chassis ground allowing either output terminal to be grounded at the user's option. Figure 2.5 shows the proper earth-ground shielding for laser diode/photodiode connections.

2.5.6 General Operating Procedure

The LDX-3207B can be operated in several modes. The following operating procedure is applicable for most common uses.

1. Plug the LDX-3207B into an AC power source which supplies the correct voltage and frequency for your unit (refer to the rear panel serial number sticker for the correct ratings).

2. Turn on the LDX-3207B by turning the key switch. Allow a one hour warm-up period for rated accuracy operation.

3. Select the desired MODE of operation with the knob on the front panel.

4. Momentarily depress the LIMIT knob and adjust it to the maximum current that you wish to source.

5. With the OUTPUT off (LED unlit), make the necessary external circuit connections. Double check to be sure that the correct polarity has been observed when connecting to laser diodes or other devices which are sensitive to being reversed biased.

6. Switch the OUTPUT on (LED lit) and adjust the current to the desired DC level using the main current setting knob. If the OUTPUT fails to turn on (LED stays unlit), check the interlock circuit. If pins 1 and 2 of CON6 are not connected through the interlock circuit, there will be no output current.

7. If needed, connect the modulation/control signal to the MOD input.

8. If a photodiode is connected, the photodiode current may be observed by pressing the DISPLAY switch to the PHOTODIODE setting (in). By putting the DISPLAY switch in the OUTPUT position (out), the display will show the output current. The photodiode feedback PD GAIN may be adjusted as necessary (see Section 2.3.17).

NOTE - At any time during the operation of the LDX-3207B, the output current limit setting may be viewed by momentarily depressing the LIMIT switch.

Chapter 3

REMOTE PROGRAMMING

3.1 Introduction

When properly installed, the model 1227 GPIB/IEEE-488 interface turns the LDX-3207B into a programmable current source for use with the IEEE Standard 488-1978 interface bus. This arrangement permits the LDX-3207B to be controlled by most computers, and makes possible a wide variety of automated test and measurement applications.

To implement IEEE-488 bus control, you will generally need to have an IEEE-488 interface adapter in your host computer. These adapters, along with appropriate software, are readily available for most popular computers, and are available from several manufacturers. This manual assumes that you have a basic knowledge of the GPIB/IEEE-488 interface bus and its use for instrument control. However, if you need application assistance, feel free to call ILX Lightwave at the number listed at the front of this manual.

3.2 Capabilities

The model 1227 GPIB/IEEE-488 interface provides control of the LDX-3207B output current level with 12 bit (0.05 mA) resolution, as well as control over the OUTPUT OFF/ON switch and audible tone (beeper). In addition, the instrument status (VOLTAGE LIMIT, CURRENT LIMIT, ON, REMOTE) can be read back over the bus. Other features include:

* Ability to read back current, photodiode current, and current limit values over the bus
* A simple and predictable command set
* 40 msec average command throughput
* Full local/remote capability, including LOCAL LOCKOUT
* Full talk/listen capability
* Selectable output terminators
* Operating mode selection capability

In addition to several device dependent commands, the 1227 interface supports the following interface messages: REN, DCL, LLO, GTL, ATN, UNT, UNL, MTA, MLA, and SDC.

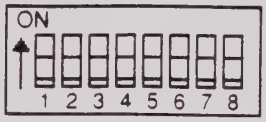
3.3 Preparation for Bus Control

Once the 1227 interface has been properly installed in the LDX-3207B (see Section 6.3), the following steps should be taken to prepare the instrument for bus control:

1. Turn off the power to the LDX-3207B and set the GPIB/IEEE-488 interface address switch as shown in Figure 3.1. The address you choose should be different from that of any other instrument connected to the bus.

2. Plug the GPIB/IEEE-488 bus cable into the LDX-3207B rear panel connector and secure it with the plug-mounted screws.

3. Turn on the LDX-3207B/1227 and press the LOCAL switch to display the selected IEEE-488 instrument address on the front panel.



SWITCH POSITIONS

ADDRESS	1	2	3	4	5
00	0	0	0	0	0
01	1	0	0	0	0
02	0	1	0	0	0
03	1	1	0	0	0
04	0	0	1	0	0
05	1	0	1	0	0
06	0	1	1	0	0
07	1	1	1	0	0
08	0	0	0	1	0
09	1	0	0	1	0
10	0	1	0	1	0
11	1	1	0	1	0
12	0	0	1	1	0
13	1	0	1	1	0
14	0	1	1	1	0
15	1	1	1	1	0
16	0	0	0	0	1
17	1	0	0	0	1
18	0	1	0	0	1
19	1	1	0	0	1
20	0	0	1	0	1
21	1	0	1	0	1
22	0	1	1	0	1
23	1	1	1	0	1
24	0	0	0	1	1
25	1	0	0	1	1
26	0	1	0	1	1
27	1	1	0	1	1
28	0	0	1	1	1
29	1	0	1	1	1
30	0	1	1	1	1
31	--NOT ALLOWED--				

(0 = OFF, 1 = ON)

Figure 3.1 Bus Address Selector Switch Settings

3.4 Remote Programming Procedure

In general, the LDX-3207B/1227 is programmed by simply sending it an ASCII string of characters that is comprised of one or more commands. A simple example would be:

"O1C50.2" In this example, the LDX-3207B output is turned on and the current is set to 50.2 mA.

On receiving this command string, the LDX-3207B is placed in REMOTE mode, the slow turn-on sequence is initiated (if the output is not already on), and the current level is commanded to go to 50.2 mA.

In order to ensure that the LDX-3207B has successfully executed these instructions, it may be desirable to read back the status of the instrument. This can be accomplished by using the G0 command:

"G0". Loads the instrument status into the interface output buffer.

Transmission of this command should be followed by execution of an instruction to read ASCII data from the interface. The interface will respond by sending a string of five ASCII characters that indicates whether the last command was understood, and it also indicates the status of the front panel indicators: VOLTAGE LIMIT, CURRENT LIMIT, ON, and REMOTE. For example, the string 00011 indicates that the previous command was understood and executed, and the instrument is operating normally in the REMOTE mode with the output ON. The G0 command is described fully in Section 3.6.6.

3.5 Command Set

There are two types of commands that you can use with the LDX-3207B/1227 and GPIB bus. Messages that only the LDX-3207B/1227 understands are called device-dependent commands. Messages that are common to any instrument on the GPIB bus are called interface messages. The device-dependent commands are summarized in Table 3.1 and are described in Section 3.6. The LDX-3207B also responds to a number of interface messages; these messages are summarized in Table 3.5.

3.6 Device-dependent Command Set

The complete LDX-3207B/1227 device-dependent command set is summarized in Table 3.1. Each of the listed commands is described fully in Sections 3.6.1 through 3.6.14.

On receiving any of the device dependent commands, the LDX-3207B/1227 is placed in REMOTE mode.

DEVICE-DEPENDENT COMMAND SET

Bn	Beeper control commands
Cnnn.nnn	Sets the output current of the LDX-3207B
CR	Gets display values of current
Dn	Selects the display mode
Fn	Operating mode selection
Gn	Get commands (error status and SRQ mask)
Mn	Turns the modulation input off or on
Nnn	Sets numeric value for SRQ mask
On	Turns the LDX-3207B output off or on
P10	Used with Nnn command to select SRQ mask
Wn	1227 Output Terminator commands
Yn	Control mode commands (LOCAL, REMOTE, LOCAL LOCKOUT)
Z0	Self test
*	Device Clear

Table 3.1 LDX-3207B/1227 Device-dependent Command Set

3.6.1 Bn (Beeper Control Commands)

The following commands effect the beeper while in REMOTE mode:

B0	Disable beeper
B1	Enable beeper
B2	Sound beeper for 1 second

3.6.2 Cnnn.nnn (Current Set Command)

The Cnnn.nnn command is used to set the output of the LDX-3207B over the GPIB/IEEE-488 bus. The numeric "n" following the command letter "C" may be formatted in a number of ways. The examples in Table 3.2 illustrate both correctly and incorrectly formatted commands.

Cnnn.nnn FORMAT EXAMPLES

CORRECT	INCORRECT
C50	CB50
C123.11	C%100
C+25	C-25
c199	

Table 3.2 Cn Command Format Examples

NOTE - The numeric field itself must be an integer or decimal number that has a value in the range of 0 to 200.

Upon receiving a correctly formatted Cn command, the LDX-3207B will switch to REMOTE mode (if it was previously in LOCAL mode) and produce an output current equal to the value of the numeric field in milliamps. That is, the command "C25" will result in an output of 25.0 mA. If the Cn command is incorrectly formatted, the LDX-3207B will still switch to REMOTE mode (if it was previously in LOCAL mode) but the REMOTE mode output current will remain at its previously set level. Additionally, the software command error flag is set whenever a command is received that cannot be interpreted. This error flag may be read using the G0 command (see Section 3.6.6).

The 1227 GPIB/IEEE-488 interface has a 12 bit (0.05 mA) analog control resolution and an accuracy of 0.1% or better.

3.6.3 CR (Get Display Value Command)

The CR (carriage return) gets the display reading, in mA, from the currently selected display. (See Section 3.6.4 for selecting the display).

3.6.4 Dn (Display Commands)

The Dn commands effect the LED display:

D0	Blanks the display
D1	Selects current display
D2	Selects current LIMIT display
D3	Selects photodiode current display

3.6.5 Fn (Operating Mode Commands)

The Fn commands are used to select the operating mode:

F0	Constant current, low bandwidth mode (default)
F1	Constant power, low bandwidth mode
F2	Constant current, high bandwidth mode

3.6.6 Gn (Get Commands)

The Gn commands are used to get the error status or the SRQ mask value:

G0	Used to read the LDX-3207B/1227 instrument status over the interface bus. Upon receiving the G0 command, the 1227 interface switches the LDX-3207B to REMOTE mode (if it was previously in LOCAL mode). Then it reads the status of the internal software command error flag, the VOLTAGE LIMIT, CURRENT LIMIT, REMOTE, and ON front panel indicators; and it loads the appropriate ASCII characters into an output buffer. The 5 character ASCII string generated by the G0 command may be read back over the bus by executing a "read" immediately after sending the G0 command.

Figure 3.4 shows the interpretation of each of the characters in the returned ASCII string. See the example programs at the end of this chapter for illustrations of how the G0 command may be used.

After loading the 5 character ASCII string into the interface output buffer, the software command error flag is reset.

G10 Gets the value of the SRQ mask and places it in the output buffer. The SRQ mask is placed into memory by the P10 command. Service requests, the serial poll register, and the SRQ mask are discussed in Sections 3.9 and 3.10.

3.6.7 Mn (Modulation Commands)

The Mn commands are used to disable/enable the MOD input while in REMOTE mode:

M0 Disables the MOD input port

M1 Enables the MOD input port

3.6.8 Nnn (Numeric Entry Commands)

The Nnn commands are used to enter the numeric values of the SRQ mask. When used with the P10 command, the numeric command will set the SRQ mask.

EXAMPLE:	EXPLANATION:
"N4 P10"	Sets the SRQ mask to generate an interrupt on a current limit condition.
"N36 P10"	Sets the SRQ mask to generate an interrupt on a current limit condition or on a software error condition.

The value of nn must be the sum of any valid SRQ mask values. For more information on setting the SRQ mask, and determining the numeric values, see Sections 3.9 and 3.10.

3.6.9 On (Output Control Commands)

The On command is used to switch the LDX-3207B output off and on. Upon receiving the On command, the LDX-3207B/1227 switches to REMOTE mode (if it was previously in LOCAL mode) and then switches the output off or on, as indicated below:

O1	Turns the output on.
O0	Turns the output off.

NOTE - It is important to point out here that since the LDX-3207B has a turn-on sequence that takes approximately 3 seconds to complete, appropriate delays must be programmed into the controlling software to avoid using the output during the turn-on sequence. In cases where it is only necessary to reduce the LDX-3207B output to zero (rather than actually shorting the output terminals) we prefer to execute a C0 command rather than a O0 command. In this case the LDX-3207B output can be rapidly increased again by simply executing another Cn command.

3.6.10 P10 (Put SRQ Mask Command)

The P10 command, in conjunction with Nn, allows the user to set the SRQ mask.

EXAMPLE:	EXPLANATION:
"N8 P10"	Sets the SRQ mask to generate an interrupt on a voltage limit condition
"N40 P10"	Sets the SRQ mask to generate an interrupt on a voltage limit condition or on a software error condition

For more information on setting the SRQ mask, see Section 3.10.

3.6.11 Wn (Terminator Commands)

The Wn commands are used to enable and disable the 1227's output (response message) terminators. The output terminators must be accepted by the controller (host computer) in order that response messages from the 1227 may be interpreted by the controller. Refer to your GPIB driver manual for the required terminator(s).

W0	Enables CR, LF, and EOI (default)
W1	Enables CR and LF only
W2	Enables CR and EOI only
W3	Enables CR only
W4	Enables LF and EOI only
W5	Enables LF only
W6	Enables EOI only
W7	Disables all output terminators

The LDX-3207B/1227 will accept any of the following terminators when receiving input (program messages) from the controller: [CR], [LF], or [EOI].

3.6.12 Yn (Control Mode Commands)

Once any device-dependent command is given, the LDX-3207B is automatically put in REMOTE mode. The Yn commands can be used to switch control modes.

Y0	Enables LOCAL mode after a Y2 or any device-dependent command is given.
Y1	Enables REMOTE mode.
Y2	Enables LOCAL LOCKOUT mode. This mode disables front panel controls, including the REMOTE/LOCAL switch. The instrument cannot be returned to LOCAL mode until the Y0 or Y1 command is sent.

IMPORTANT

The interface messages GTL, REN, and LLO perform the same operations as Y0, Y1, and Y2 respectively. Either set can be used, but they CANNOT be mixed. For example, after using Y1 do not try to use GTL to go back to local mode. In this case, the GTL interface message will be ignored; the Y0 command should be used instead.

3.6.13 Z0 (Self Test Command)

The Z0 command tests the beeper and front panel LEDs. After the test, the LDX-3207B/1227 is reset to the power-on condition.

Since the LDX-3207B/1227 is reset at the end of the self test, the Z0 command should only be sent by itself. The LDX-3207B/1227 will ignore any subsequent commands in a command string.

3.6.14 * (Clear Command)

The * command resets the LDX-3207B/1227 to the power-up default settings: CONST I, LOW BW mode, OUTPUT OFF, beeper enabled, MOD input enabled, SRQ mask cleared, and voltage limit cleared. The REMOTE mode is also selected.

The * is executed in its proper turn in a string, just like any other command. The * command is useful to ensure that the LDX-3207B/1227 is initialized to the same state each time a program is run.

NOTE - The SDC and DCL interface messages perform the same function as the * command.

3.7 Input Syntax

This section describes the syntax rules for constructing device-dependent command strings used to control the LDX-3207B/1227. In general, a command string is formed by a series of individual commands followed by a terminator.

The recognized device-dependent command set is given in Section 3.6. The LDX-3207B/1227 accepts alphabetic characters in either upper or lower case. Commands may be strung together into an ASCII string of up to 30 characters in length. Any characters beyond the 30th are truncated. Certain characters are ignored and may be included anywhere in a command string for clarity. These ignored characters are shown in Figure 3.2.

Space	" "
Back slash	"/"

Figure 3.2 Ignored Characters

A command string must be concluded with one or more input (program message) terminators. Acceptable input terminators are shown in Figure 3.3. Processing of the command string begins when the first input terminator is received.

Carriage return	[CR]	ASCII (013)
Line feed	[LF]	ASCII (010)
EOI	[EOI]	

Figure 3.3 Input (Program Message) Terminators

Illegal commands and unrecognized characters (e.g. O3) cause the software error flag to be set, but are otherwise ignored. Examples of correct and incorrect command strings are given in Table 3.3.

DEVICE-DEPENDENT COMMAND STRINGS

CORRECT COMMAND STRINGS	
"O1C100" [CR]	Turns the output on and causes the output to go to 100 mA. Note that if the output was previously off, the turn-on sequence will take approximately 3 seconds to complete.
'c0c100c0" [CR][LF]	Either upper or lower case alphabetic characters may be used. This command string results in an output current pulse approximately 40 msec long.
"C+10 G0/" [EOI]	Spaces (and back slashes) may be used within the command string for clarity. This command string causes the output to go to 10 mA then loads the instrument status into the output buffer.
"O1 C25.378 B2" [LF]	Causes the output to go to 25.378 mA (to within the resolution and accuracy of the interface) and then sound the LDX-3207B/1227 internal beeper.
INCORRECT COMMAND STRINGS	
"O1 @ C100" [EOI]	The @ is an unrecognized character. When the @ is encountered the software error status bit is set and processing continues normally.
"C0 C100.0 C B2" [CR]	A numeric was expected following the third "C". The omission of this numeric will cause the software error status bit to be set, but processing will continue normally beginning with the B2 command.
"O1 B3 c10.011" [CR]	B3 is an unknown command. When the B3 command is encountered the software error status bit will be set and processing will continue normally with the next command.
"C1.00E-1 B2" [CR]	This command will cause the output to go to 1.00 mA, followed by a beep. Although "1.00E-1" is often used as scientific notation to mean 0.100, the LDX-3207B/1227 does not recognize this form of notation. In this case the "E-1" is interpreted as an unrecognized command causing the software error status bit to be set.

Table 3.3 Command String Examples

3.8 Output (Response Message) Syntax

The LDX-3207B/1227 loads the instrument status into the interface output buffer in response to a G0 command. The output is comprised of a string of five ASCII characters. The interpretation of these characters is shown in Figure 3.5. The instrument status may then be read by the controller by sending a "read device" program message. The instrument status then becomes a response message, with a response message terminator appended to it. (The response message terminator is determined by the Wn command.

3.9 Service Requests

Service requests let bus instruments get the attention of the controller (host computer). If more than one instrument on the bus is capable of sending service requests, the controller can learn which one made the request by taking a serial poll. Each device, including the LDX-3207B, responds to the poll by sending the contents of its serial poll register. The serial poll register indicates whether the device requested service, and if so, the reason for the request. Service requests are sent over a separate line (one of the IEEE-488 bus lines called the SRQ line) and do not affect the output buffer.

The LDX-3207B/1227 can be programmed to make a service request on user-specified conditions. The conditions are specified by entering a value for the service request (SRQ mask) with the P10 command (this value can be read by using the G10 command). The SRQ mask is a two digit integer that specifies which conditions will generate a service request. The SRQ mask works by selectively ignoring any unspecified conditions of all the conditions that are monitored by the serial poll register in the LDX-3207B.

3.10 Serial Poll Register and SRQ Mask

The serial poll register is a binary register which contains eight bits, as shown in Table 3.4. The SRQ mask can enable any combination of the valid serial poll register bits: 2, 3, or 5. The decimal value of any combination of these binary digits may be used to set the mask. Its six-bit binary representation is AND-ed bit-for-bit with error register bits 0 through 5, and the results are sent to the serial poll register. If any mask-enabled bit in the serial poll register comes true, the RQS bit (bit 6) is set true, generating a service request.

At power-up, or on any device clear command, the SRQ mask is set to 00. This prevents service requests by holding each bit false under all conditions. The serial poll register is cleared whenever the LDX-3207B/1227 receives a new input command string. Table 3.4 contains the bit representation used by the LDX-3207B/1227 in the serial poll register.

SERIAL POLL REGISTER VALUES

Bit	Decimal Value	Condition
0	--	Not used
1	--	Not used
2	4	Current limit
3	8	Voltage limit
4	--	Not used
5	32	Software error
6	--	(RQS line)
7	--	Not used

Table 3.4 Serial Poll Register

3.11 Interface Messages

In addition to the device-dependent command set described above (Section 3.6), the LDX-3207B/1227 responds to a number of interface messages in order to participate in IEEE-488 bus communication. Programmers working with high level languages (like BASIC) generally need not be concerned with these messages since they are often handled by the internal software drivers. The interface messages understood by the LDX-3207B/1227 are listed in Table 3.5. All of these messages originate at the controller.

3.12 Example Programs

Two example programs are shown in Examples 3.1 and 3.2. These programs exercise all of the remotely accessible LDX-3207B/1227 features in the process of recording a laser diode's output vs. drive current characteristic.

```
10 '                    *** LIDATA ***
20 '
30 ' Program to measure and print light output vs. current input for
40 ' a laser diode or LED. SRQ capabilities are used.
50 '
60 ' An LDX-3207B is used to drive the emitter, and the light output is
70 ' measured using CONST P, LOW BW mode and the D-sub connector for
80 ' photodiode feedback.
90 '
100 ' The GPIB bus address of the LDX-3207B must be set to address 1.
110 '
120 ' This program was written for use with an IBM PC/XT or compatible
130 ' using IOTech's GP488 controller card and PERSONAL488 software
140 ' (IOTech, P.O.Box 21204, Cleveland, OH 44121).
150 '
160 ' The program was written in Microsoft's GWBASIC and will also run
170 ' under IBM's BASICA.
180 '
190 ' -------------------- INITIALIZE PROGRAM PARAMETERS
200 '
210 ADDR$ = "01"                                    'LDX-3207B GPIB bus address
220 '
230 IDMIN = 50                                      'Set min drive current.
240 IDMAX = 100                                     'Set max drive current.
250 IDINC = 2                                       'Set drive current step increment.
260 RESP = 1!                                       'Detector responsivity (A/W)
270 '
280 ' -------------------- INITIALIZE THE GPIB DEVICE DRIVERS
290 '
300 OPEN "\DEV\IEEEOUT" FOR OUTPUT AS #1
310 OPEN "\DEV\IEEEIN" FOR INPUT AS #2
320 IOCTL#1,"BREAK"                                 'Clear driver.
330 PRINT#1,"RESET"
340 PRINT#1,"OUTPUT";ADDR$;";*"                     'Clear LDX-3207B.
350 '
360 ' ------------------- INITIALIZE OUTPUT/PRINT HEADER
370 '
380 CLS                                             'Clear the screen.
390 '
400 PRINT "    *** LASER/LED OUTPUT vs. DRIVE CURRENT ***"
410 PRINT
420 PRINT "                  DRIVE CURRENT       OUTPUT"
430 PRINT "                    (mA)              (mW)"
440 PRINT "                  =============    ==============="
450 '
```

Example 3.1
Remote Programming Example Using GWBASIC (Microsoft Corp.)

```
460 ' ---------------------------------- INITIALIZE LDX-3207B
470 '
480 PRINT#1, "OUTPUT";ADDR$;";C50 O1"                'Set LDX-3207B as follows:
490                                                  ' C50  Output current = 50 mA.
500                                                  ' O1  Output on.
510 '
520 FOR X=1 TO 1000 : NEXT X                         'Wait for output to be set.
530 PRINT#1,"OUTPUT";ADDR$;";G0"
540 PRINT#1,"ENTER";ADDR$                            'Command LDX-3207B to load
545                                                  'status bits.
550 IF VAL(A$) <> 11 THEN 900                        'Check instrument status.
560 PRINT#1, "OUTPUT";ADDR$;";N44 P10"               'Set SRQ mask for interrupt
570                                                  'on software or limit error.
580 '
590 PRINT#1,"OUTPUT";ADDR$;";D3"                     'Set display for photodiode current.
600 '
610 ' ---------------------------------- TAKE DATA
620 '
630 FOR I = IDMIN TO IDMAX STEP IDINC                'Initialize current loop.
640 '
650 C$ = STR$(I)                                     'Write I to an ASCII string.
660 C$ = "C" + C$                                    'Append the "C" command character.
670 '
680 PRINT#1,"OUTPUT";ADDR$;";";C$                    'Send current level to LDX-3207B;
690 PRINT#1,"STATUS":INPUT#2,STS$
700 PRINT#1,"SPOLL":INPUT#2,SRQ                      'Check SRQ status.
710 IF SRQ <> 0 THEN 1000
720 '
730 PRINT#1,"OUTPUT";ADDR$                           'Get photodiode current.
735 FOR X = 1 TO 1000: NEXT X                        'Wait for display to stabilize.
740 PRINT#1,"ENTER";ADDR$
750 INPUT#2,A$
760 L = RESP * VAL(A$) * 1000                        'Convert reading to milliwatts.
770 '
780 ' ---------------------------------- PRINT OUT RESULTS
790 '
800 IMAGE$ = "                ###.##         ###.##"
810 PRINT USING IMAGE$;I,L                           'Print out results.
820 '
830 ' ---------------------------------- DONE
840 '
850 NEXT I                                           'Close loop.
860 '
```

Example 3.1
Remote Programming Example Using GWBASIC (Cont'd)

```
870 END
880 '
890 ' ---------------------- INITIALIZING ERROR PROCESSING
900 '
910 BEEP                                        'Sound tone.
920 PRINT VAL(A$)                               'Print error bits (see Figure 3.4).
930 PRINT "CURRENT SOURCE NOT READY."           'Print error message.
940 END
1000 '
1010 ' ---------------------- SRQ INTERRUPT SERVICE ROUTINE
1020 '
1030 PRINT "SRQ INDICATES ERROR"                'Print SRQ error message.
1040 END
```

Example 3.1
Remote Programming Example Using GWBASIC (Cont'd)

```
'                    *** LIDATA2 ***
'
' Program to measure and print light output vs. current input for
' a laser diode ar LED. SRQ capabilities are used.
'
' An LDX-3207B is used to drive the emitter, and the light output is
' measured using CONST P, LOW BW mode and the D-sub connector for
' photodiode feedback.
'
' The GPIB bus address of the LDX-3207B must be set to address 1.
'
' This program was written for use with an IBM PC/XT or compatible
' using IOTech's GP488 controller card and PERSONAL488 software
' (IOTech, P.O.Box 21204, Cleveland, OH 44121).
'
' The program was written in Microsoft's QuickBASIC.
'
' ---------------------------- INITIALIZE PROGRAM PARAMETERS
'
ADDR$ = "01"                                    'LDX-3207B GPIB bus address.
'
IDMIN = 50                                      'Set min drive current.
IDMAX = 100                                     'Set max drive current.
IDINC = 2                                       'Set drive current step increment.
RESP = 1!                                       'Detector responsivity (A/W).
'
' --------------------------- INITIALIZE THE GPIB DEVICE DRIVERS
'
OPEN "\DEV\IEEEOUT" FOR OUTPUT AS #1
OPEN "\DEV\IEEEIN" FOR INPUT AS #2
IOCTL#1,"BREAK"                                 'Clear driver.
PRINT#1,"RESET"
PRINT#1,"OUTPUT";ADDR$;";*"                     'Clear LDX-3207B.
'
' ------------------------- INITIALIZE OUTPUT/PRINT HEADER
'
CLS                                             'Clear the screen.
'
PRINT "       *** LASER/LED OUTPUT vs. DRIVE CURRENT *** "
PRINT
PRINT "                  DRIVE CURRENT       OUTPUT"
PRINT "                       (mA)            (mW)"
PRINT "                  =============     ==============="
'
```

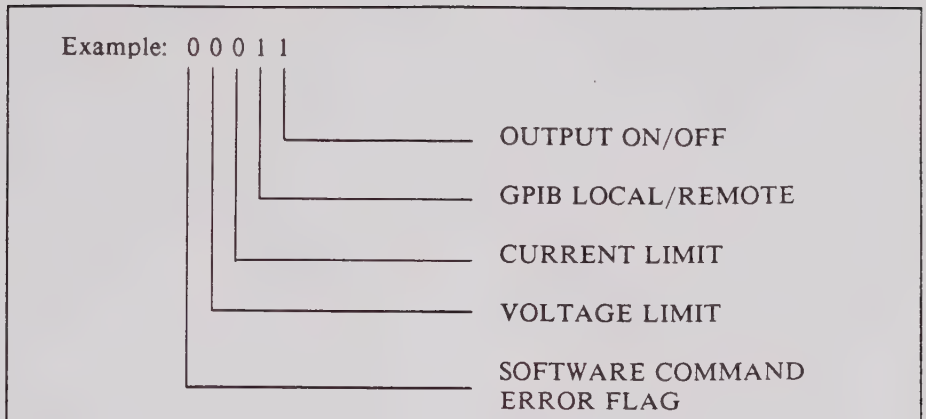
Example 3.2
Remote Programming Example Using QuickBASIC

```
' ------------------------------- INITIALIZE LDX-3207B
'
PRINT#1, "OUTPUT";ADDR$;";C50 O1"          'Set LDX-3207B as follows:
                                           ' C50  Output current = 50 mA.
                                           ' O1  Output on.
FOR X = 1 TO 1000 : NEXT X                 'Wait for output to be set.
PRINT#1,"OUTPUT";ADDR$;";G0"
PRINT#1,ENTER";ADDR$                       'Command LDX-3207B to load status bits.
IF VAL(A$) <> 11 THEN                      'Check instrument status.
 '
 ' ------------------- INITIALIZING ERROR PROCESSING
 '
 BEEP                                      'Sound tone.
 PRINT VAL(A$)                             'Print error bits (see Figure 3.4).
 PRINT "CURRENT SOURCE NOT READY."         'Print error message.
 END
 ELSE
 PRINT#1,"OUTPUT";ADDR$;";N44 P10"         'Set SRQ mask for interrupt on
                                           'software or limit error.
 '
 PRINT#1,"OUTPUT";ADDR$;";D3"              'Set display for photodiode current.
 '
 ' ------------------------------- TAKE DATA
 '
 DIM S$(100)
 FOR I = IDMIN TO IDMAX STEP IDINC         'Initialize current loop.
   '
   C$ = S$(I)                              'Write I to an ASCII string.
   C$ = "C" + C$                           'Append the "C" command character.
   '
   PRINT#1,"OUTPUT";ADDR$;";";C$           'Send current level.
   PRINT#1,"STATUS":INPUT#2,STS$
   PRINT#1,"SPOLL":INPUT#2,SRQ             'Check SRQ status.
   IF SRQ <> 0 THEN
         '
         ' ------------------- SRQ INTERRUPT SERVICE ROUTINE
         '
         PRINT "SRQ INDICATES ERROR"       'Print SRQ error message.
         END
      ELSE
         PRINT#1,"OUTPUT";ADDR$            'Get photodiode current.
         FOR X = 1 TO 1000: NEXT X         'Wait for display to stablize.
         PRINT#1,"ENTER";ADDR$
         INPUT#2,A$
         L = RESP * VAL(A$) * 1000         'Convert reading to mW.
         '
```

Example 3.2
Remote Programming Example Using QuickBASIC (Cont'd)

```
        '------------------------ PRINT OUT RESULTS
        '
        IMAGE$ = "                ###.##        ###.##"
        PRINT USING IMAGE$;I,L                      'Print out results.
    END IF
  NEXT I                                            'Close loop.
END IF
END
```

Example 3.2
Remote Programming Example Using QuickBASIC (Cont'd)



		N = 0	N = 1
OUTPUT	nnnn<u>N</u>	OFF	ON
GPIB LOCAL/REMOTE	nnn<u>N</u>n	LOCAL	REMOTE
CURRENT LIMIT	nn<u>N</u>nn	NOT ACTIVE	ACTIVE
VOLTAGE LIMIT	n<u>N</u>nnn	NOT ACTIVE	ACTIVE
SOFTWARE COMMAND ERROR FLAG	<u>N</u>nnnn	NOT SET	SET

Figure 3.4
Interpretation of the ASCII String Generated in Response to a G0 Command

INTERFACE MESSAGES

MLA	My Listen Address - Addresses the 1227 to listen.
MTA	My Talk Address - Addresses the 1227 to talk.
UNL	Unlisten - Addresses all devices to unlisten.
UNT	Untalk - Addresses all talkers to untalk.
ATN	Attention - A uniline message that instructs the 1227 to interpret information on the data lines as a mulitiline command (such as MLA or UNL), otherwise that information is interpreted as data by all active listeners.
DCL	Device Clear - A multiline message that causes the 1227 to reset to its power-up configuration: output current set to 0.00 mA, mode set to LOCAL.
LLO	Local Lockout - A multiline message that disables all LDX-3207B front-panel controls except the LIMIT knob.
GTL	Go To Local - Causes the LDX-3207B to switch to LOCAL mode.
SDC	Selected Device Clear - Causes the LDX-3207B/1227 to reset to its power-up configuration: output off, mode to LOCAL. This command differs from DCL above in that it affects only the addressed interface, whereas DCL affects all listeners on the bus.
REN	Remote Enable - A uniline message which, when received with MLA, switches the LDX-3207B/1227 to REMOTE mode. When REN is set false, the LDX-3207B/1227 switches to LOCAL mode and removes the local lockout.

Table 3.5 Interface Messages

Chapter 4

THEORY OF OPERATION

4.1 Introduction

This chapter covers the theory of operation for the LDX-3207B. Sections on the modes of operation and GPIB/IEEE-488 bus control are included, as well as the theory of operation for the current source, OUTPUT switch, and other features.

4.2 Overview

An overall functional block diagram of the LDX-3207B is shown in Figure 4.1. The fundamental current path is along the right-hand side of the figure, flowing from top to bottom. When the output is active, regulated current is produced in the current source and is then either dumped to ground or diverted to the positive output terminal. The precise amount of current flowing though the output terminals is determined by the current bypass circuit. The output is switched off and on by an FET switch in parallel with the output terminals. When the output is off, the FET is "on", causing the current to bypass the outputs. This arrangement of current source, current bypass, and FET shunt switch provides current control, precision current limit capability, and transient-free operation.

The amount of current sourced by the upper current source is determined by the current limit setting. This current always flows except briefly when the compliance voltage of the supply is exceeded. Current leaving the current source can: (1) pass through the output terminals, (2) bypass the output terminals via the FET switch, or (3) dump to ground, bypassing both the FET switch and output terminals.

Control of the precision current sink depends on the control mode of the LDX-3207B:

> LOCAL MODE - In this mode, the amount of current entering the current bypass circuit depends on the sum of: the main current, set by the main output adjustment knob; and the external control signal, derived from the modulation input port.
>
> REMOTE MODE - In this mode, the amount of current entering the current bypass circuit depends on a D/A control signal set by the optional 1227 GPIB/IEEE-488 interface and the modulation (MOD) input port. The MOD input port may be enabled or disabled over the GPIB (see Section 3.12).

In either case, the maximum amount of current available to the current bypass circuit is limited to the current being produced by the upper current source.

The internal power supplies (Diagram 7.3) include a regulated 5 to 12 volt supply (rear panel adjustable COMPL V, Diagram 7.4) for the current source and a +15 volt, a -15 volt, and two +5 volt regulated supplies for the internal analog and digital circuitry. The extra +5 volt isolated supply is used by the 1227 GPIB/IEEE-488 interface board when it is installed. All I/O lines to and from the interface board are optically isolated. This allows the LDX-3207B ground system to remain floating with respect to the GPIB bus.

The +15 and -15 volt supplies use a conventional full-wave, center-tapped bridge rectifier (BR2) arrangement followed by three-terminal regulators (VR6, VR7). Similarly, the isolated +5 volt supply is based on a conventional full-wave bridge rectifier (BR1) followed by a three-terminal regulator (VR4). The main +5 volt supply shares the same bridge rectifier (D4 - D7) used by the current source, although each is supplied by a separate filter capacitor (C64, C62). The +5 volts is regulated by VR5. The current source supply is regulated by VR1.

Transient protection begins with a line filter module at the power entry point. Over-voltage transients and spikes are clipped with metal oxide varistors MOV1 - MOV3. Capacitors C54, C55 and C111 also help remove noise. The power transformer (T1) is wound on a split bobbin to minimize capacitive coupling from the transformer primaries to secondaries, and includes three levels of shielding.

4.4 Current Source

The internal current source is formed by U4:B, Q4, and R50 (Diagram 7.4). Current flowing through R50 is sensed and compared to a reference level set by the position of the front panel CURRENT LIMIT knob. U4:B drives the base of Q4 to maintain the current source output level at the desired point. The compliance voltage of this current source is set by voltage regulator VR1. This output voltage is normally set to 10 volts. The user may adjust it in a range of 5 to 12 volts by turning the COMPL V pot (R43) on the rear panel (see Section 2.3.16).

The voltage across R50 is amplified by U8, passed by analog switch U6:D (Diagram 7.5), and read by the integrating A/D converter U17. This data is then used to update the display when the CURRENT LIMIT button is pressed, and is sent out over the GPIB when requested.

4.5 Current Bypass Circuit

The current bypass circuit (Diagram 7.5) is formed by U1, Q2, and R10 (Low BW mode) or U202, Q2, R1, and R2 (High BW mode). In Low BW mode, amplifier U1 compares the voltage produced at R10 to a control voltage at its inverting input and drives the gate of Q2 to ensure that these voltages are equal. In High BW mode, the voltage at R1 is compared to the control voltage at the inverting input of U202. The output of U202 drives the gate of Q2 to maintain the proper output current.

The control voltage comes from SUM_SIGNAL line via U203. Five signals can be summed: the front panel knob signal, MOD input (U9, Diagram 7.4), GPIB controller set point (D/A converter U11 and op amp U10), and output current feedback (U4:C, pin 8, Diagram 7.5) or photodiode current feedback (U3). These signals can be enabled and disabled with analog switches in U6, U7, and U2. Notice that the D/A converter cannot be disabled. Its output is simply set to zero when the D/A is not used.

Operation is as follows:

In LOCAL mode, the front panel knob and MOD input signals are enabled and summed. The D/A converter is set to zero.

In REMOTE mode, the front panel knob is disabled and the D/A and MOD inputs are summed. The MOD input can be enabled and disabled remotely with the "Mn" commands (see Section 3.6.7).

If photodiode feedback current is used, the output of U200:A (Diagram 7.5) is enabled. If CONST I, LOW BW mode is used, the current feedback from U4:C is enabled. If either photodiode or output current is fed back, integrator U5 is switched into the feedback path via U2:B. Otherwise, the feedback path through U202 is enabled (High BW mode).

4.6 OUTPUT Off/On Switch

Output off/on switching is accomplished by a JFET (Q1, Diagram 7.5) which shunts the output terminals. When the gate of Q1 is near ground potential to +5 volts, the FET channel resistance is low causing current to bypass the output terminals, effectively shutting off the output. Even though a small on-state drain-source voltage will exist across Q1 (due to its finite on resistance), diode D13 ensures that no current flows through the output terminals.

The gate of Q1 is tied to ground through capacitor C7. In order to turn the outputs on, Q1 must be biased off by charging C7 to at least -8 volts. The slow LDX-3207B turn-on characteristic is accomplished by limiting the charge rate of C7 via R8.

The output is turned off rapidly by discharging C7 through Q3. The base of Q3 is controlled by the flip-flop formed by gates U20:B and U20:C (Diagram 7.3) through invertor U19:B (Diagram 7.5). This flip-flop is set (disables current output) at power-on through U18:D (Diagram 7.4). Also at any time during operation, this flip-flop can be set four ways: (1) If the AC power fails, the power-line monitor circuit made up of D3, R97, R69, and U18:A will set the flip-flop. (2) If an open circuit condition occurs, the flip-flop is set through U18:C. (3) The flip-flop sets if the microprocessor U13 fails to toggle the T1 (U13, pin 15) line up and down. If this failure occurs, the watch dog circuit made from U20:A, C94, C116, D11, D12, R89, and C95 will set the flip-flop. (4) The microprocessor may also set the flip-flop through line INT0 (U13, pin 12).

The only way the flip-flop can be cleared is under microprocessor command over line P1.1 from U13, pin 2. Clearing the flip-flop turns the output on. The microprocessor receives input control information from the front panel on lines P1.2 to P1.7. It talks to the 1227/GPIB interface over serial lines RXD and TXD. Current limit sense is received from U18:B into the INT1 line.

An 82C55, 24 line, parallel port (U14) is controlled by the microprocessor. These 24 output lines are used to control the front panel, load the D/A converter U11 (used to set the current from the GPIB), and control the analog switches which configure the operating modes.

4.7 Modes of Operation

Figure 4.1 is an overall block diagram of the LDX-3207B. However, each mode of operation has different configurations for the output and feedback circuits. Sections 4.7.1 - 4.7.3 describe the theory of each of the modes of operation. Figures 4.2 - 4.4 contain block diagrams for each of the mode's output and feedback configuration.

4.7.1 Constant Current, High Bandwidth Mode

In CONST I, HIGH BW mode the feedback path is through U202 (Diagram 7.5). The current output is controlled by the front panel control knob, MOD port, and optional GPIB/IEEE-488 if it is installed and operating. In this mode a voltage feedback is routed through R221 to amplifier U202. See Figure 4.2 for a block diagram of this configuration.

4.7.2 Constant Power, Low Bandwidth Mode

In CONST P, LOW BW mode the feedback path is through integrator U5 via analog switch U7:D (Diagram 7.5). The integrator acts as a filter to sharp transients, and therefore prevents the output from changing too rapidly. This gives added laser diode protection.

The current output is controlled by the front panel control knob, MOD port, and optional GPIB/IEEE-488 if it is installed and operating. In addition, the photodiode feedback from U200:A is enabled through U7:D. In this mode, voltage feedback is routed through R220 to amplifier U1. See Figure 4.3 for a block diagram of this configuration.

In this mode, the bandwidth of the external modulation is decreased to about 10 Hz.

4.7.3 Constant Current, Low Bandwidth Mode

In CONST I, LOW BW mode the feedback path is through integrator U5 via U2:B (Diagram 7.5). The integrator acts as a filter which prevents sharp transients from reaching the output.

The current output is controlled by the front panel control knob, MOD port, and optional GPIB/IEEE-488 if it is installed and operating. In addition, the current feedback from the output is fed back to integrator U5 through U7:A to control the output current. In this mode, voltage feedback is routed through R220 to amplifier U1. See Figure 4.4 for a block diagram of this configuration.

In this mode, the bandwidth of the external modulation is decreased to about 10 Hz.

4.8 Modulation/Voltage Control Input Port

The front panel MOD input connector drives a precision, wide-band instrumentation amplifier (U9, Diagram 7.4) allowing the control signal applied to this port to use a different ground than the current output terminals of the LDX-3207B. However, due to the input common-mode voltage restrictions of the U9, the MOD input should be within ±10 volts of the current output terminals.

The inputs to U9 are connected so that when the center pin of the MOD input BNC connector is positive with respect to the shell, an increase in output current results. The inputs to U9 are protected by the network formed by R67, C51, and R62.

Normally, the MOD port is always enabled. However, if REMOTE mode of the optional GPIB controller is used to disable the MOD port, the MOD port will be disabled upon returning to LOCAL mode.

4.9 GPIB/IEEE-488 Bus Control

With the optional 1227 GPIB/IEEE-488 interface installed, the LDX-3207B may be controlled by most computers via the GPIB/IEEE-488 bus. When the 1227 interface receives any of its recognized commands, it puts the LDX-3207B in the REMOTE mode. In this mode, the current bypass circuit receives its analog control signal from the D/A converter U11 which is set by the 1227/GPIB board, rather than from the main current control knob (see also Section 4.5). The 1227 can set the LDX-3207B control mode (LOCAL/REMOTE), output state (OFF/ON), beeper, display, MOD port, MODE of operation, and can initiate a LOCAL LOCKOUT mode. All communications between the 1227 and the LDX-3207B is over an optically isolated, full-duplex, serial data link operating at 1200 baud.

When LOCAL LOCKOUT mode is active, all front panel controls are inhibited except for the LIMIT knob, and the LDX-3207B may only be controlled via the GPIB/IEEE-488 interface. This mode is useful when the instrument is used in an automated test setup where front panel control is undesirable.

4.10 Photodiode Feedback Amplifier

Photodiode feedback is amplified by U3 and U200:A (Diagram 7.5), with the gain selected by selecting the appropriate feedback resistor R18 - R22 or R94 via switch SW1. This feedback signal is routed into integrator U5, through switch U7:D, where it controls the current output.

Normally, the photodiode feedback gain is set so that a full scale knob (or GPIB) setting will produce the correct maximum photodiode feedback current (light power). See Section 2.3.17 for details on photodiode feedback gain adjustment.

4.11 External Modulation Bandwidth in CONST P Mode

In CONST P, LOW BW mode the bandwidth of the external modulation is decreased to about 10 Hz because of capacitor C2. This capacitor reduces noise and keeps the current from changing too rapidly if the connections to the laser diode are momentarily broken and re-made. Higher frequency components in the modulation will result in a mixture of optical light-power modulation and current modulation to the laser.

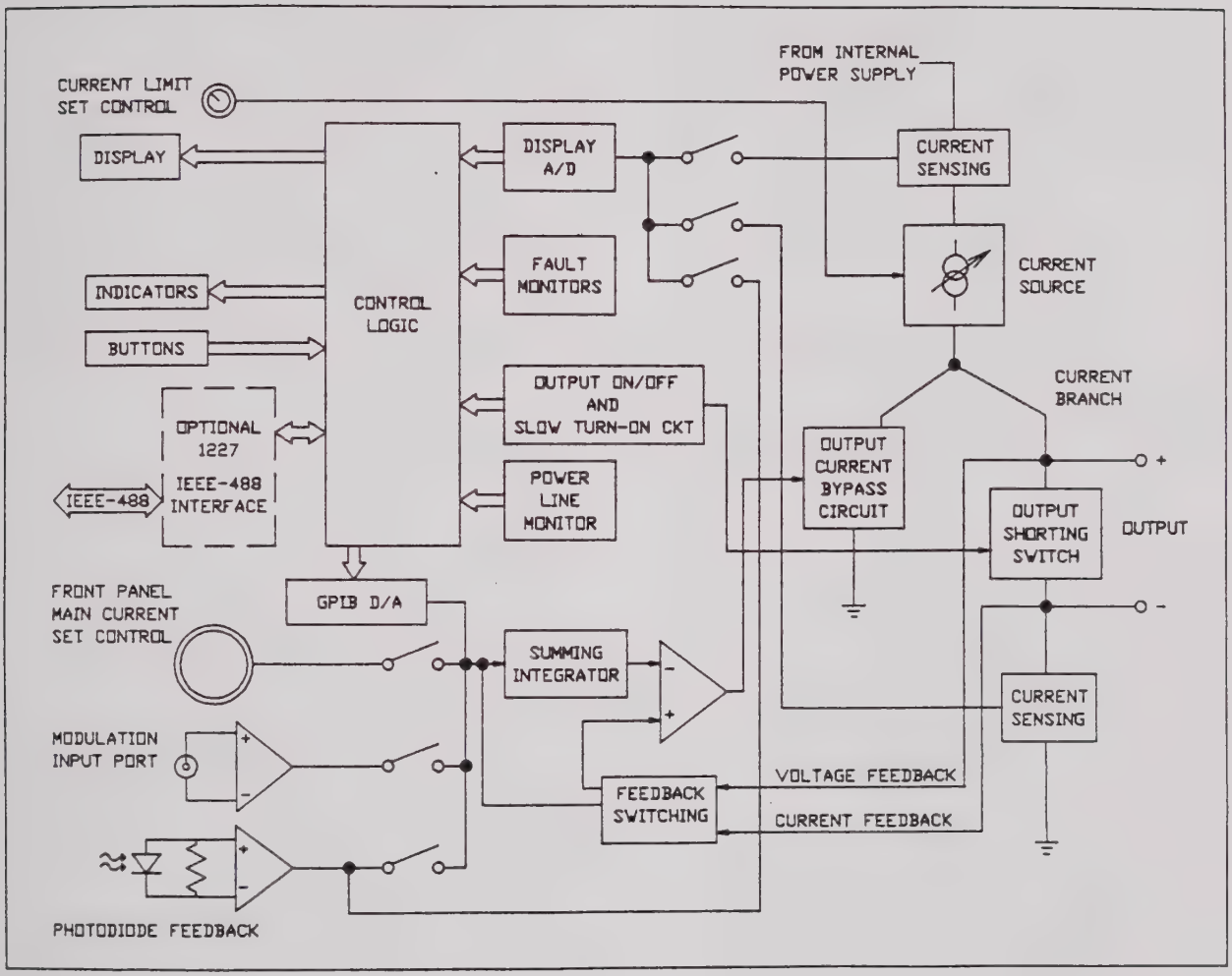


Figure 4.1 LDX-3207B Functional Block Diagram

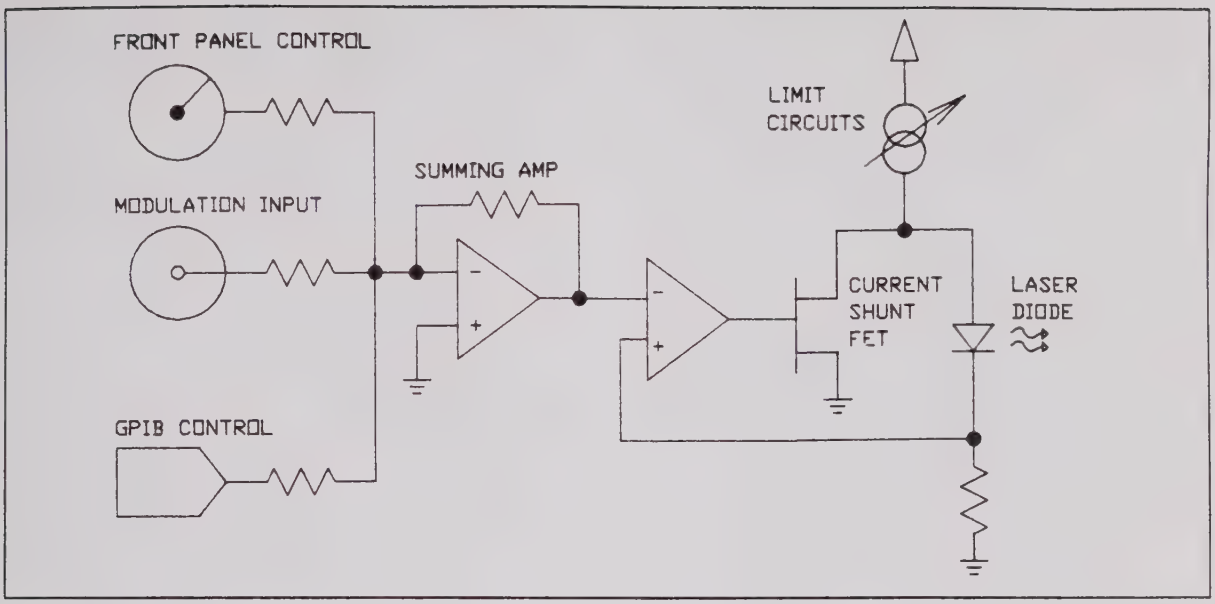


Figure 4.2 CONST I, HIGH BW Mode Block Diagram

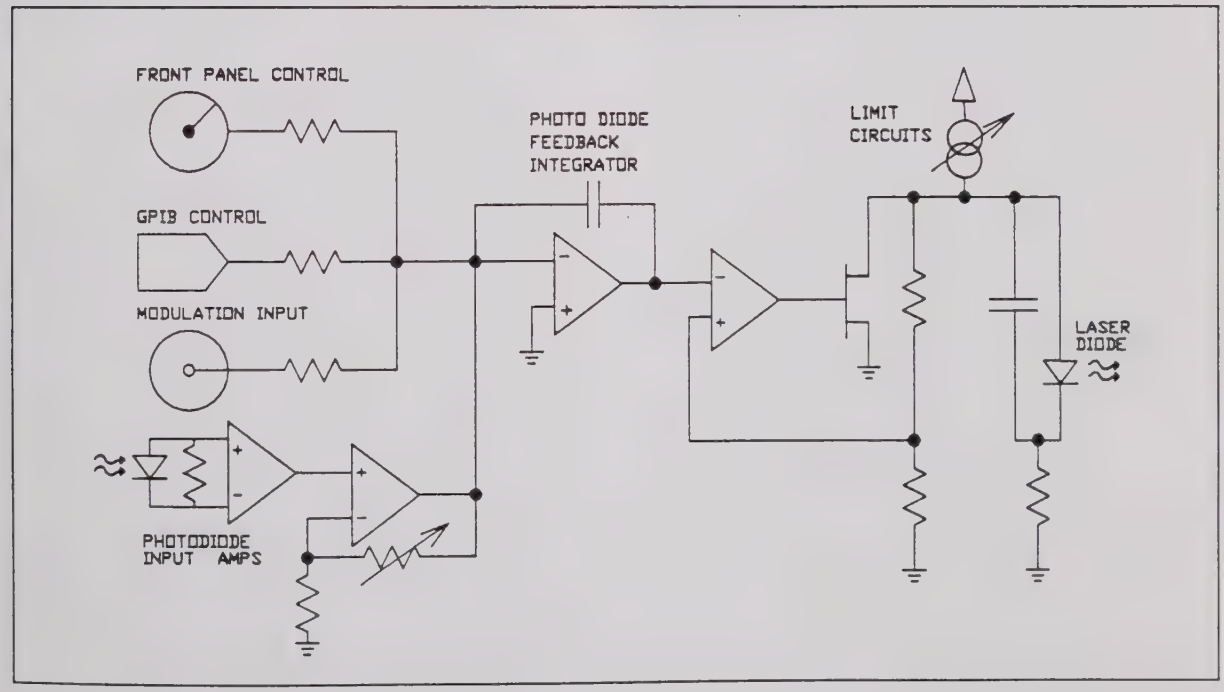


Figure 4.3 CONST P, LOW BW Mode Block Diagram

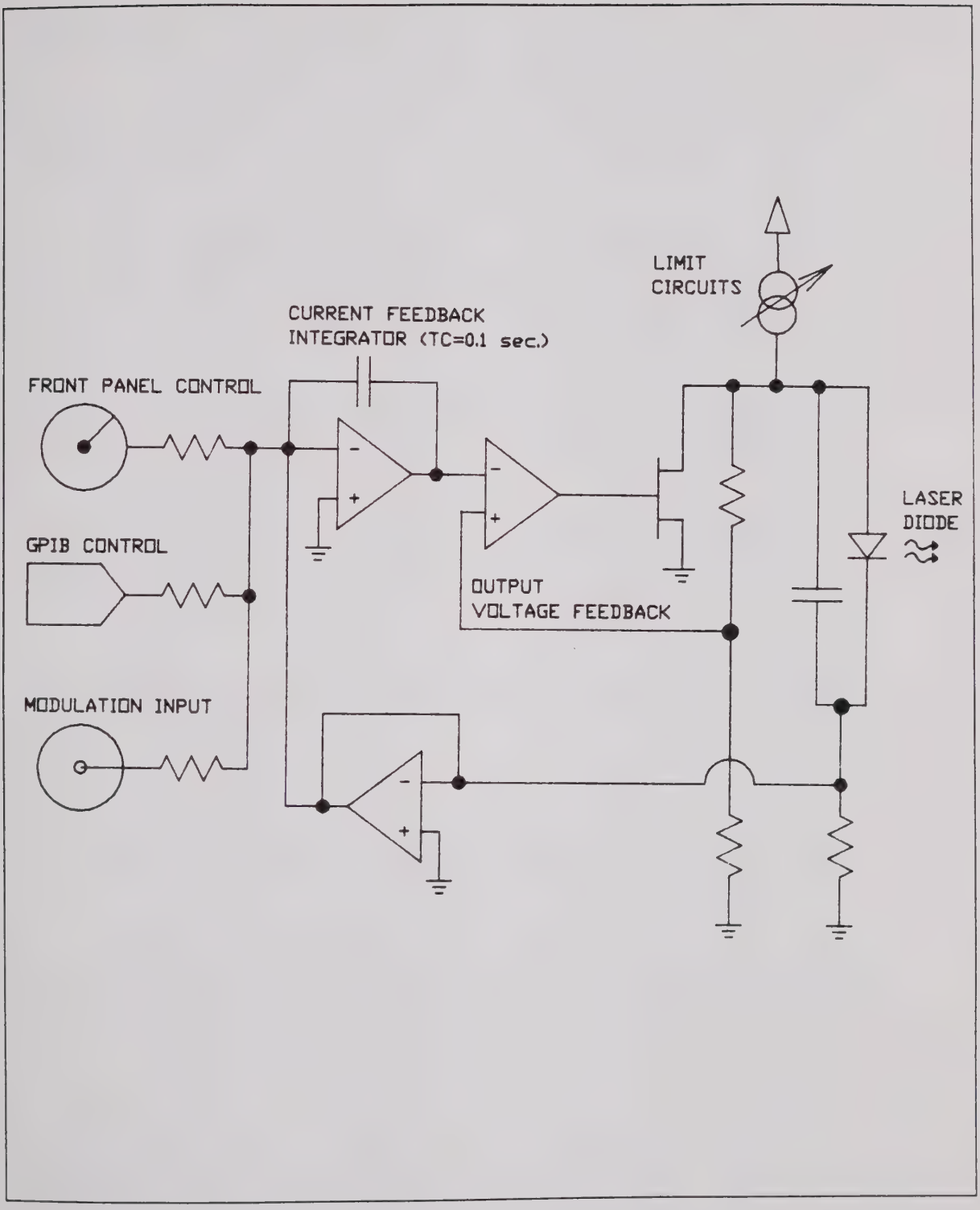


Figure 4.4 CONST I, LOW BW Mode Block Diagram

Chapter 5

MAINTENANCE

WARNING

THE SERVICE PROCEDURES DESCRIBED IN THIS CHAPTER ARE FOR USE BY QUALIFIED PERSONNEL. POTENTIALLY LETHAL VOLTAGES EXIST WITHIN THE LDX-3207B. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY OF THE PROCEDURES DESCRIBED IN THIS CHAPTER UNLESS YOU ARE QUALIFIED TO DO SO.

AUTHORIZED SERVICE PERSONNEL ARE REQUIRED TO WEAR PROTECTIVE EYEGLASSES AND ANTI-STATIC WRIST STRAPS WHEN WORKING ON THE LDX-3207B CIRCUITS.

CAUTION! HIGH VOLTAGES EXIST ON AND AROUND THE PRINTED CIRCUIT BOARD OF THE LDX-3207B.

5.1 Introduction

This chapter contains information necessary to maintain the LDX-3207B. Included are sections covering calibration, fuse replacement, line voltage selection, and disassembly.

5.2 Calibration

The LDX-3207B should be recalibrated every 12 months or whenever performance verification indicates that recalibration is necessary.

5.3 Recommended Equipment

Recommended test equipment for calibrating the LDX-3207B is listed in Table 5.1. Equipment other than that shown in the table may be used so long as the specifications meet or exceed those listed.

RECOMMENDED TEST EQUIPMENT

Description	Mfr./Model	Specification
DMM	Fluke 8840A	DC Volts (@ 1.0 V): 0.008%
		Resistance (@ 10 ohms): 0.054%
Resistor, 10 ohm	Wirewound 3 W,	Low TC: 50 ppm/°C
Resistor, 100 ohm	any type	1/2 W
DC Power Supply	Capable of Ripple:	<5 mV 1 V output

Table 5.1 Recommended Test Equipment

5.4 Environmental Conditions

Calibration should be performed under laboratory conditions. We recommend calibration at 23°C, ±1°C. However, when necessary, the LDX-3207B may be calibrated at its intended use temperature so long as this is within the specified operating temperature range of 0 to 50°C.

5.5 Warm-Up

The LDX-3207B should be allowed to warm up for at least 1 hour before calibration is performed. During the warm-up period the LIMIT knob should be set to approximately half scale (100 mA).

5.6 Calibration Adjustments

In the calibration procedure that follows, the output current of the LDX-3207B is determined by measuring the voltage drop across a shunt resistor. Then the current is calculated by using Ohm's Law (I=V/R). Although this procedure is more cumbersome than direct current measurement, it generally yields greater accuracy than direct current measurement when using conventional 5-1/2 digit DMMs. Refer to Diagram 7.1 to locate the adjustment pots.

1. Measure Resistance of 10 Ohm Shunt

With the Fluke 8840A in 4-WIRE OHMS mode, measure and record the resistance of the 10 ohm and 100 ohm (nominal) shunt resistors.

The following steps require that the top cover of the LDX-3207B be removed. This is easily accomplished by removing the two screws on either side of the cover near the rear of the instrument (see also Section 5.9). Where possible, perform the calibration steps with the cover slid back about 1 inch.

If the model 1227 GPIB option is installed, it will be necessary to remove it from the chassis of the LDX-3207B (see Section 6.3). However, it is not necessary to disconnect its ribbon connector cable. Carefully place the 1227 to one side at a static-free work station while making the calibration adjustments.

2. Power Supply Check

Turn R59 (located at the center of main PCB) fully counter-clockwise (CCW). Turn the LDX-3207B on and check the following voltages:

a. At pin 3 of VR4 and pin 3 of VR5 there should be +5 V, ±0.3 V.
b. At pin 3 of VR6 there should be -15 V, ±0.5 V.
c. At pin 3 of VR7 there should be +15 V, ±0.5 V.
d. Using R39 (located at center of main PCB), adjust the +10 V reference at pin 19 on U11 to 10.23 V, ±0.005 V.

3. Compliance Voltage Adjustment

The compliance voltage sets the maximum voltage that can appear across the current output terminals. To set this voltage:

a. Connect the 100 ohm resistor across the output terminals.
b. Turn the current output knob fully counterclockwise for zero mA output.
c. Place the Fluke 8840A in VOLTS mode and measure the voltage drop across the 100 ohm resistor.
d. Select CONST I, HIGH BW mode, turn the OUTPUT on, and increase the output current until the compliance voltage that you desire is reached.
e. If the VOLTAGE LIMIT LED lights up before you reach the desired compliance voltage value, turn the COMPL V pot (R43), on the rear panel, clockwise several turns and repeat Steps 3a - 3e.
f. Lower the compliance voltage threshold by turning the COMPL V pot counterclockwise until the VOLTAGE LIMIT LED lights up.

The compliance voltage should be set in the range of 2 to 5 volts, although a somewhat wider range may be achieved if desired.

4. Current Limit Full Scale Calibration

   a. Connect the 10 ohm resistor across the output, and connect the Fluke 8840A to measure the voltage across the resistor.
   b. Select CONST I, HIGH BW mode and turn the OUTPUT on.
   c. Turn the current LIMIT knob fully clockwise.
   d. Turn the output current knob fully clockwise.
   e. Adjust pot R48 (located near transformer) until the meter display reads 2.050 V, ±0.005 V.

5. Current Limit Display Calibration

   a. Connect the 10 ohm resistor across the output, and connect the Fluke 8840A to measure the voltage across the resistor.
   b. Select CONST I, HIGH BW mode and turn the OUTPUT on.
   c. Turn the current LIMIT knob fully clockwise.
   d. Turn the output current knob fully clockwise.
   e. Turn the current LIMIT knob until a voltage of about 2.001 V is reached.
   f. Adjust pot R53 (located near U8 on main PCB) until the display has the same reading as the voltmeter (multiplied by R, the measured resistance of the nominally 100 ohm calibration resistor) when the current LIMIT display knob is depressed.

6. Current Output Knob full Scale Calibration

   a. Connect the 10 ohm resistor across the output, and connect the Fluke 8840A to measure the voltage across the resistor.
   b. Select CONST I, HIGH BW mode and turn the OUTPUT on.
   c. Turn the current output knob fully clockwise (full scale).
   d. Adjust pot R59 (located at the center of the main PCB) until the voltmeter reads 2 * R, ±0.00025 V.

7. Current Display Calibration

   a. Connect the 10 ohm resistor across the output, and connect the Fluke 8840A to measure the voltage across the resistor.
   b. Select CONST I, HIGH BW mode and turn the OUTPUT on.
   c. Adjust R59 (located at the center of main PCB) to get a voltage of 2.0010 V, ±0.0001 V on the voltmeter.
   d. Adjust pot R79 (located near the transformer) until the LDX-3207B display reads the same value as the voltmeter multiplied by the quantity: 1000/R, where R is the measured calibration resistance recorded earlier.

8. CONST I, LOW BW Full Scale Calibration

   a. Connect the 10 ohm resistor across the output, and connect the Fluke 8840A to measure the voltage across the resistor.
   b. Select CONST I, LOW BW mode and turn the OUTPUT on.
   c. Turn the current output knob fully clockwise (full scale).

d. Adjust pot R27 (located near U1 on the main PCB) until the voltmeter reads 2 * R, ±0.001 V, where R is the resistance measured of the nominal 100 ohm resistor.

9. Modulation Gain Adjustment

a. Connect the 10 ohm shunt resistor (or any low ohm shunt) across the LDX-3207B output terminals.
b. Set the current output knob for 0.0 mA output, and turn the OUTPUT on.
c. With a DC power supply, apply a 1.00 volt nominal signal to the LDX-3207B front panel MOD input connector, with the center pin of the connector positive with respect to the shell.
d. With the Fluke 8840A in VOLTS mode, measure and record the actual voltage applied to the MOD input.
e. Adjust R64 (located near U6 on the main PCB) until the output display of the LDX-3207B indicates an output current equal to the MOD input voltage multiplied by the scale factor 100 mA/volt:

I = (100 mA/volt) * (Input voltage)

For example, if the input voltage is 1.012 volts, then adjust R64 until the LDX-3207B display reads 101.2 mA. (Be sure that the DISPLAY is set for an output current reading).

10. CONST P Photodiode DISPLAY Calibration

a. Connect the 1.000 voltage source to the photodiode feedback input (J401, (-) pin 6 and (+) pin 7).
b. Select CONST P, LOW BW mode.
c. Adjust R15 (located at the rear of the main PCB) until the display reads 1.100 mA.

11. Final Check

a. Connect the 10 ohm resistor across the output, and connect the Fluke 8840A to measure the voltage across the resistor.
b. Turn the output control knob fully clockwise (CW).
c. At approximately 50, 100, and 150 mA check the current limit and ensure that the current limit disply matches the actual limited current to within 3 mA.
d. Turn the current limit fully clockwise (CW) and check the accuracy of the display to the actual current at increments of about 25 mA. The display should not differ by more than 0.1 mA.
e. Repeat Step 11 for all operating modes, repeat entire calibration if necessary.

This completes the calibration procedure. Reinstall the top cover and its retaining screws.

5.7 Fuse Replacement

The fuse is accessible from the rear panel of the LDX-3207B. Before replacing the fuse, turn power off and disconnect the line cord. Use only the fuses indicated below in Table 5.2.

FUSE REPLACEMENT GUIDE

Line voltage	Fuse Replacement
90 - 110 VAC	1/4 Amp, 3AG, Slow Blow
108 - 132 VAC	1/4 Amp, 3AG, Slow Blow
198 - 242 VAC	1/8 Amp, 3AG, Slow Blow
216 - 264 VAC	1/8 Amp, 3AG, Slow Blow

Table 5.2 Fuse Replacement

5.8 Line Voltage Selection

Line voltage selection is made by installing jumpers accessible with the bottom cover of the LDX-3207B removed (see Section 5.9 Disassembly). Normally these jumpers are factory preset. However, when necessary they may be moved to accommodate new line voltage conditions.

To proceed, turn off the LDX-3207B's power, disconnect the line cord, turn over the LDX-3207B, and remove the bottom cover. Locate the jumpers located on the main circuit board near the rear panel of the instrument. In order to change the line voltage selection these jumpers must be relocated as indicated in Figure 5.1. Carefully unsolder the jumpers and then reinstall them in the new positions.

There are five jumper positions, each of which has two nominal voltages. Horizontally connect all of the jumpers for the desired line voltage. For example, if 100 VAC is selected, all of the jumpers with 100 marked beside the holes should be connected. Figure 5.1 shows the proper connections for 100, 120, 220, and 240 VAC operation.

5.9 Disassembly

The top and bottom covers of the LDX-3207B may be removed by simply removing the countersunk screws located on the sides of the instrument near the rear panel. Once these screws are removed, either cover may be removed by sliding it towards the rear of the instrument and then pulling it up and off.

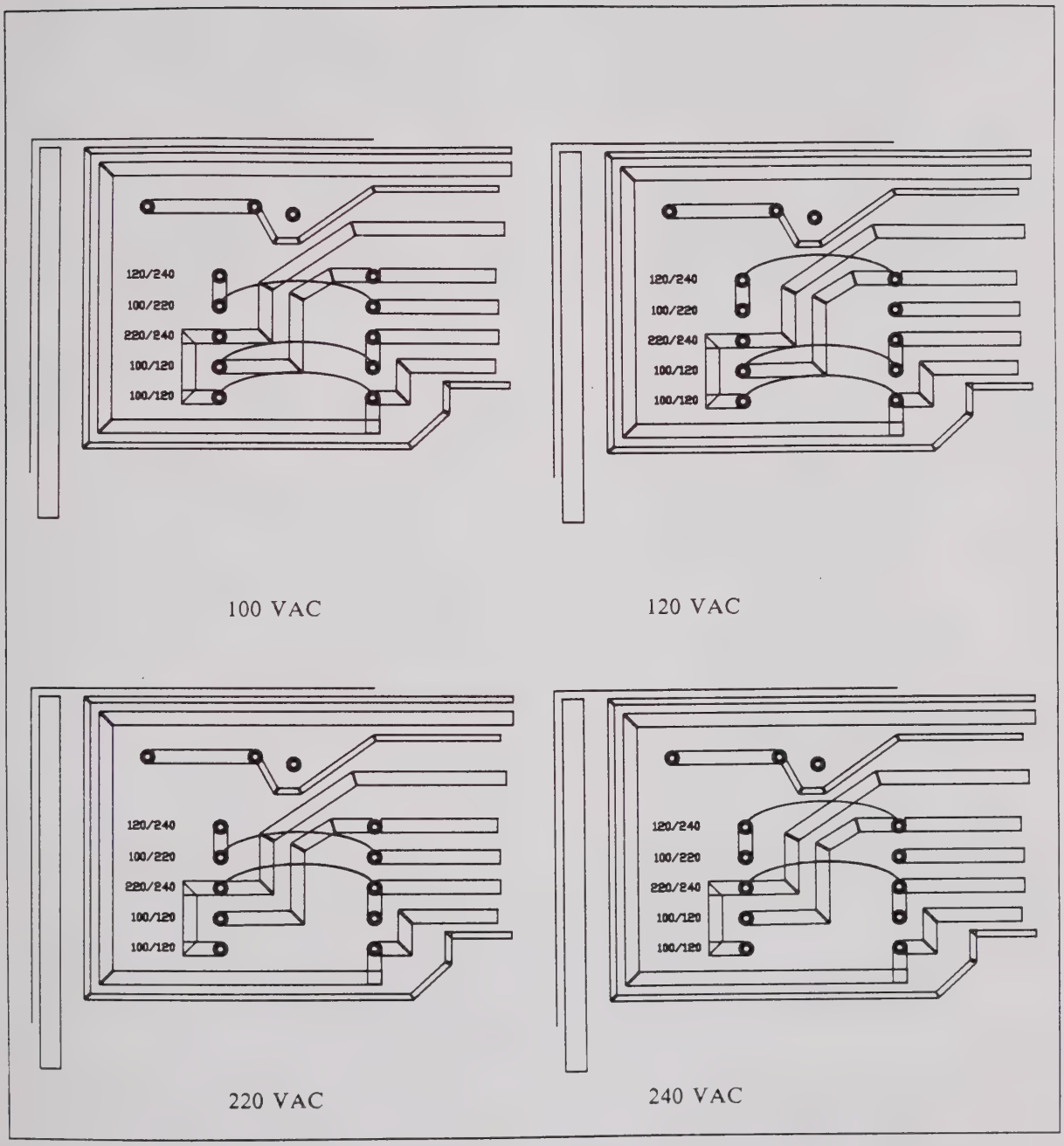


Figure 5.1 Line Voltage Selection

Chapter 6

OPTIONAL MODEL 1227 GPIB/IEEE-488 INTERFACE

6.1 Introduction

This chapter describes the optional model 1227 GPIB/IEEE-488 interface which allows the LDX-3207B to be remotely programmed via the IEEE standard 488-1978 interface bus. For a description of the remote programming procedure refer to Chapter 3.

6.2 Specifications

IEEE-488 BUS IMPLEMENTATION

GENERAL:	Implements talker/listener functions
INTERFACE MESSAGES:	REN, DCL, LLO, GTL, SDC, ATN, UNT, UNL, MTA, MLA

DEVICE DEPENDENT COMMAND STRUCTURE:

Command	Function
Bn	Beeper commands
Cnnn.nnn	Set output current to nnn.nnn mA
CR	Get display reading command
Dn	Display commands
Fn	Operating MODE commands
Gn	Get status and SRQ commands
M0, M1	MOD input disable/enable
Nnn	Enter numeric values for setting SRQ mask
O0,O1	Switch output: 0=off, 1=on
P10	Put (set) the SRQ mask
Wn	Terminator commands
Yn	Control mode commands
Z0	Self test
*	Device clear

ISOLATION:	Instrument is optically isolated from IEEE-488 bus
COMMAND EXECUTION TIME:	Approximately 40 mSec

ACCURACY:

ANALOG CONTROL RESOLUTION:	12 bit (0.05 mA)
ANALOG CONTROL ACCURACY:	±0.1 mA

SIGNAL INPUT FROM INSTRUMENT:

A single signal line operating at 1200 baud

SIGNAL OUTPUT TO INSTRUMENT:

A single signal line operating at 1200 baud

6.3 Installation

IMPORTANT

ILX Lightwave will not warranty customer installation of the Model 1227 GPIB interface option.

We recommend that the model 1227 interface may be installed at the factory. Following the procedure outlined below when it is necessary to move the 1227 board for calibration:

a. Turn off the LDX-3207B and disconnect it from the AC line.

b. Remove the top cover of the LDX-3207B by removing the two cover retaining screws located on either side of the instrument near the rear panel.

c. Place the 1227 board to the side of the LDX-3207B, resting it on a static-free, non-conductive surface.

IMPORTANT

The 1227 GPIB/IEEE-488 interface board contains static sensitive parts. Handle the circuit board only by its edges and work at a static free work station.

d. Refer to Section 6.4 for the calibration of the 1227. Follow Step 2. It is necessary to do this calibration with the 1227 board out of the LDX-3207B cabinet in order to have easy access to R110 (located near center of the main PCB).

e. With the calibration procedure finished, fasten the 1227 interface board onto the rear panel ensuring that the GPIB connector and address

selector switch are centered in their respective panel cutout holes. Note that the 1227 interface board must be mounted upside down (components facing down) to be correctly installed. Use the supplied GPIB connector retaining screws, lock washers and nuts to secure the circuit board to the rear panel.

f. Tighten the screw in the side rail support locking the support into place.

g. When finished, the 1227 should be installed as shown in Figure 6.1. Replace the top cover and screws.

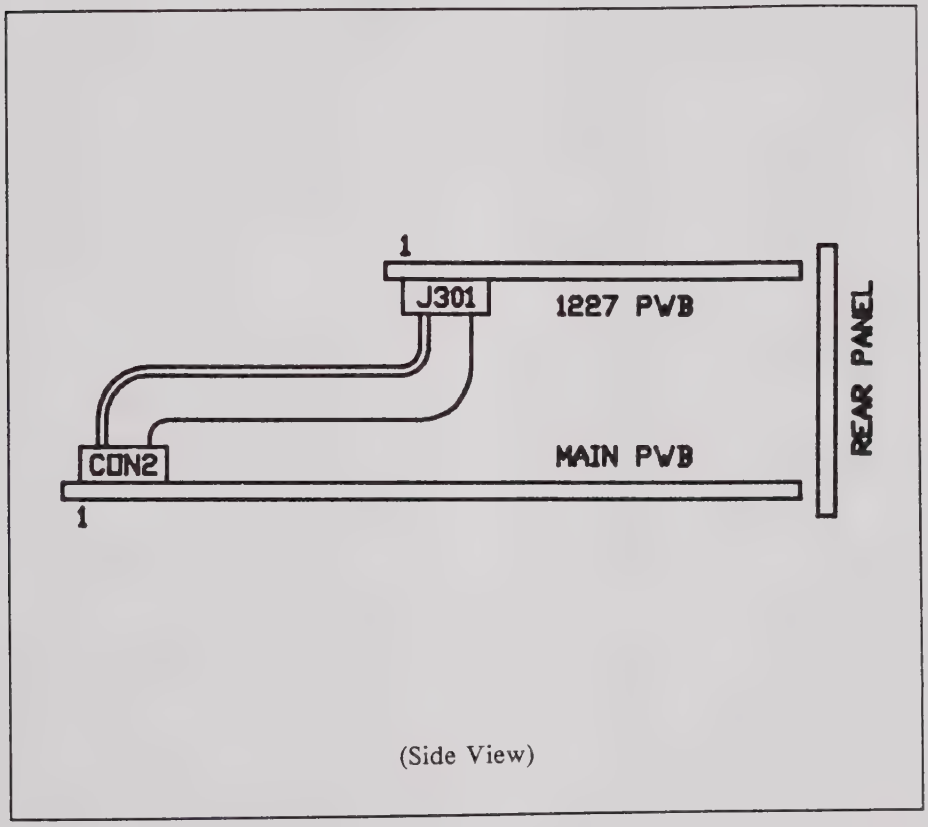


Figure 6.1
Cross-Sectional View of Properly Installed 1227 Interface Board

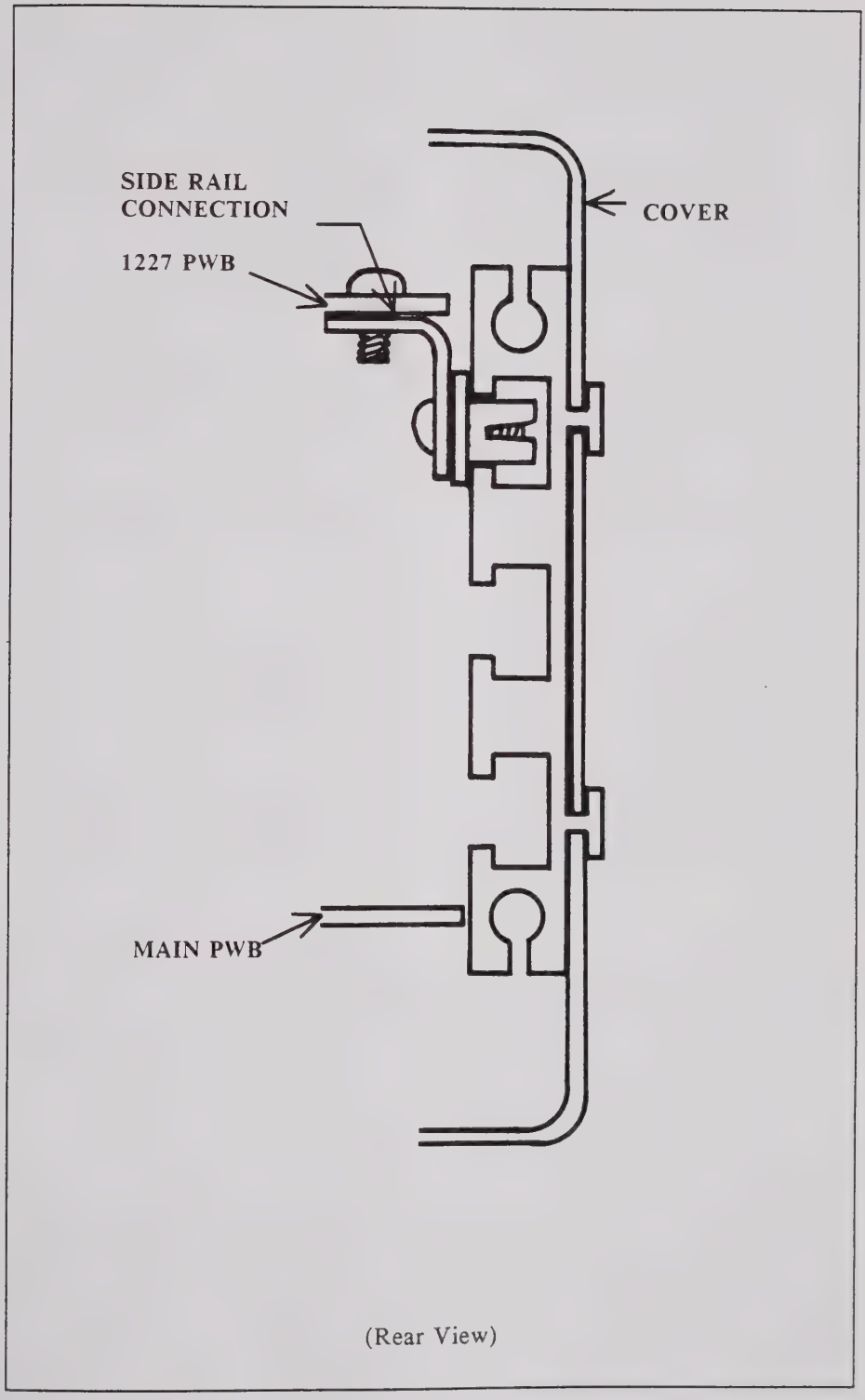


Figure 6.2 1227 Interface Board - Side Rail Connection

6.4 Calibration

WARNING

THE SERVICE PROCEDURES DESCRIBED IN THIS SECTION FOR USE BY QUALIFIED PERSONNEL. POTENTIALLY LETHAL VOLTAGES EXIST WITHIN THE LDX-3207B. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY OF THE PROCEDURES DESCRIBED IN THIS SECTION UNLESS YOU ARE QUALIFIED TO DO SO.

QUALIFIED SERVICE PERSONNEL ARE REQUIRED TO WEAR PROTECTIVE EYEGLASSES AND ANTI-STATIC WRIST BANDS WHILE WORKING ON THE LDX-3207B CIRCUIT BOARDS.

CAUTION! HIGH VOLTAGES ARE PRESENT ON AND AROUND THE PRINTED CIRCUIT BOARDS OF THE LDX-3207B.

Before performing the procedures described below, ensure that the LDX-3207B is fully warmed up with both covers in place (see Section 5.2). To perform the following calibration steps you will need a Fluke 8840A, 5-1/2 digit DMM (or equivalent) and a 10 ohm shunt resistor as described in Section 5.3.

In the calibration procedure that follows, the output current of the LDX-3207B is determined by measuring the voltage drop across a shunt resistor and then calculating the current using Ohm's Law (I = V/R). Although this procedure is more cumbersome than direct current measurement, it generally yields greater accuracy with conventional 5-1/2 digit DMMs.

1. Measure Resistance of 10 Ohm Shunt

With the Fluke 8840A in 4-WIRE OHMS mode, measure and record the resistance of the 10 ohm (nominal) resistor. Calculate the voltage drop across the shunt resistor for a 100.00 mA output current:

V = (0.1000) * (Measured Shunt Resistance)

Record this calculated voltage for use in Step 2 below.

The following steps require that the top cover of the LDX-3207B be removed, the 1227 board unfastened from the LDX-3207B, and the 1227 board set aside. However, the electrical connector ribbon cable should not be disconnected. Remove the screws on the top rear sides of the LDX-3207B and remove the top panel. Remove the screws from the 1227 which hold it to the LDX-3207B side rails, and remove the bolts on the rear panel which fasten the GPIB connector jack. Set the 1227 board on a static free, non-conductive surface next to the LDX-3207B.

2. 1227 GPIB/IEEE-488 Interface Calibration

a. Connect the 10 ohm shunt resistor to the output of the LDX-3207B.

b. Set the address of the 1227 interface to an unused address (see Section 3.3) and connect the interface to the GPIB bus via the rear panel connector.

c. Send the following ASCII string to the 1227 interface from the bus controller:

"O1 C200"

This will put the LDX-3207B in REMOTE mode, turn the OUTPUT on, and set the output to approximately 200.0 mA.

Refer to Example 6.1 for an illustration of how this command string would be sent using an IBM PC and IOTech GP488 controller card as the controller. For a more complete description of remote programming of the 1227, refer to Chapter 3.

d. With the Fluke 8840A in DC VOLT mode, measure the voltage drop across the 10 ohm shunt resistor. Adjust R123 (located near U9 on the main PCB, see Diagram 7.1) until the voltage drop is equal to that calculated for a 200.01 mA current (±0.005 mA), as calculated above in Step 1.

e. Send the following ASCII string: "C10". This will set the output to approximately 10.00 mA.

Adjust R110 (located near U11) until the voltage drop is equal to that calculated for a 10.0025 mA current (±0.0005 mA), as calculated in Step 1.

f. Repeat Steps 2d and 2e two or three times until both currents are within the specified tolerances. If calibration is not successful at this point, contact ILX Lightwave. Otherwise send the ASCII string "C200" and adjust R79 (located near the transformer) so that the display reads 200 mA, if necessary.

g. Wait 3 minutes, then repeat Steps 2e and 2f, if necessary. Then, check the calibration by sending ASCII string commands "C10", "C20", "C30" ... "C200", in increments of 10 mA, and confirm each entry by calculating the output current as in Step 2e. The calculated values should be within ±0.15 mA of the set values.

Repeat Step 8 of the main board calibration procedure (see page 59). If it was necessary to adjust R79 in Step 2f (above), the Current Display Calibration must be performed also (Step 7, page 59).

This completes the 1227 interface calibration procedure. Turn the power off and reinstall the LDX-3207B cover and retaining screws.

```
10 '                *** CALIBRATE ***
20 '
30 'Program to put the LDX-3207B in REMOTE mode, turn the OUPTUT
40 'on, and set the output to 100.0 mA. This program is written in GWBASIC
50 'and assumes that a IOTech488 controller card is installed on an IBM PC
60 'or compatible.
70 '
80 'This program also assumes that the address of the LDX-3207B is set to 1.
90 '
100 '---------------------------------- INITIALIZE GPIB
110 '
120 ADDR$ = "01"                                    'Set GPIB address to 1.
130 '
140 OPEN "\DEV\IEEEOUT" FOR OUTPUT AS #1
150 OPEN "\DEV\IEEEIN" FOR INPUT AS #2
152 IOCTL#1,"BREAK"                                 'Clear driver.
154 PRINT#1,"RESET"
156 PRINT#1,"OUTPUT";ADDR$;";*"                     'Clear LDX-3207B.
160 '
170 '---------------------------------- SEND COMMANDS
180 '
190 PRINT#1, "OUTPUT";ADDR$;";C100 O1"              'Set output for 100 mA.
192 FOR X = 1 TO 10000: NEXT X                      'Wait for turn on to complete.
194 PRINT#1,"OUTPUT";ADDR$;";G0"
200 PRINT#1, "ENTER";ADDR$
210 INPUT#2, A$                                     'Get instrument status bits.
220 IF VAL(A$) <> 11 THEN 500                       'Check instrument status.
230 '
240 '---------------------------------- DONE
250 '
260 PRINT "PROGRAM SUCCESSFULLY TERMINATED."
270 END
280 '
500 '---------------------------------- PROCESS ERROR RETURNS
510 '
520 BEEP
525 PRINT VAL(A$)                                   'Print error bits (see Figure 3.4).
530 PRINT "COULD NOT INITITIALIZE DEVICE."
540 END
```

Example 6.1 Program Example for Calibration Command Sequence

Chapter 7

SCHEMATIC DIAGRAMS

7.1 Main Circuit Board Component Layout

7.2 Front Panel Circuit Board Component Layout

7.3 Main Board PD Feedback/Current Output Schematic Diagram

7.4 Main Board Digital Section/Power Supplies Schematic Diagram

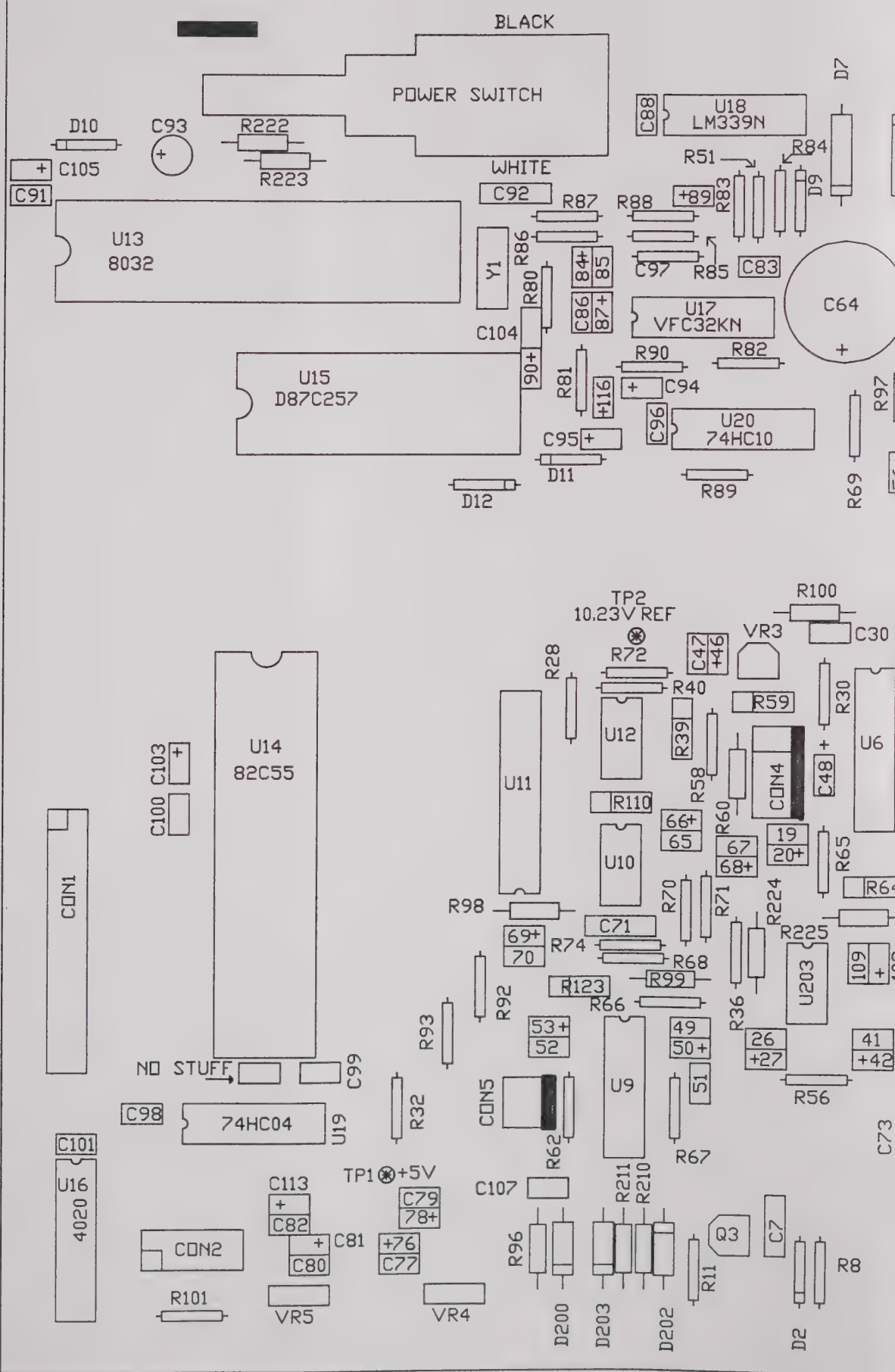
7.5 Main Board Current Limit/MOD Input Schematic Diagram

7.6 Front Panel Circuit Board Schematic Diagram

7.7 Model 1227 GPIB/IEEE-488 Schematic Diagram

7.8 Model 1227 GPIB/IEEE-488 Component Layout

7.9 3207B Power Route Schematic Diagram


BLACK
POWER SWITCH
WHITE
U13
8032
U15
D87C257
U14
82C55
U18
LM339N
U17
VFC32KN
U20
74HC10
U16
4020
74HC04
U19
U12
U11
U10
U9
U6
CON1
CON2
CON4
CON5
U203
Y1
C64
C104
C105
C91
C92
C93
C94
C95
C96
C97
C98
C99
C100
C101
C103
C107
C113
C79
C80
C81
C82
C83
C86
C88
D10
D11
D12
D7
D9
D200
D203
D202
D2
R222
R223
R87
R88
R89
R90
R82
R84
R51
R85
R86
R80
R81
R83
R69
R97
R100
R28
R72
R40
R59
R30
R39
R58
R110
R60
R65
R98
R70
R71
R224
R225
R74
R68
R99
R123
R66
R92
R93
R36
R56
R32
R62
R67
R96
R211
R210
R11
R8
Q3
C7
C73
C30
C47
C48
TP2
10.23V REF
TP1
+5V
VR3
VR4
VR5
R101
NO STUFF

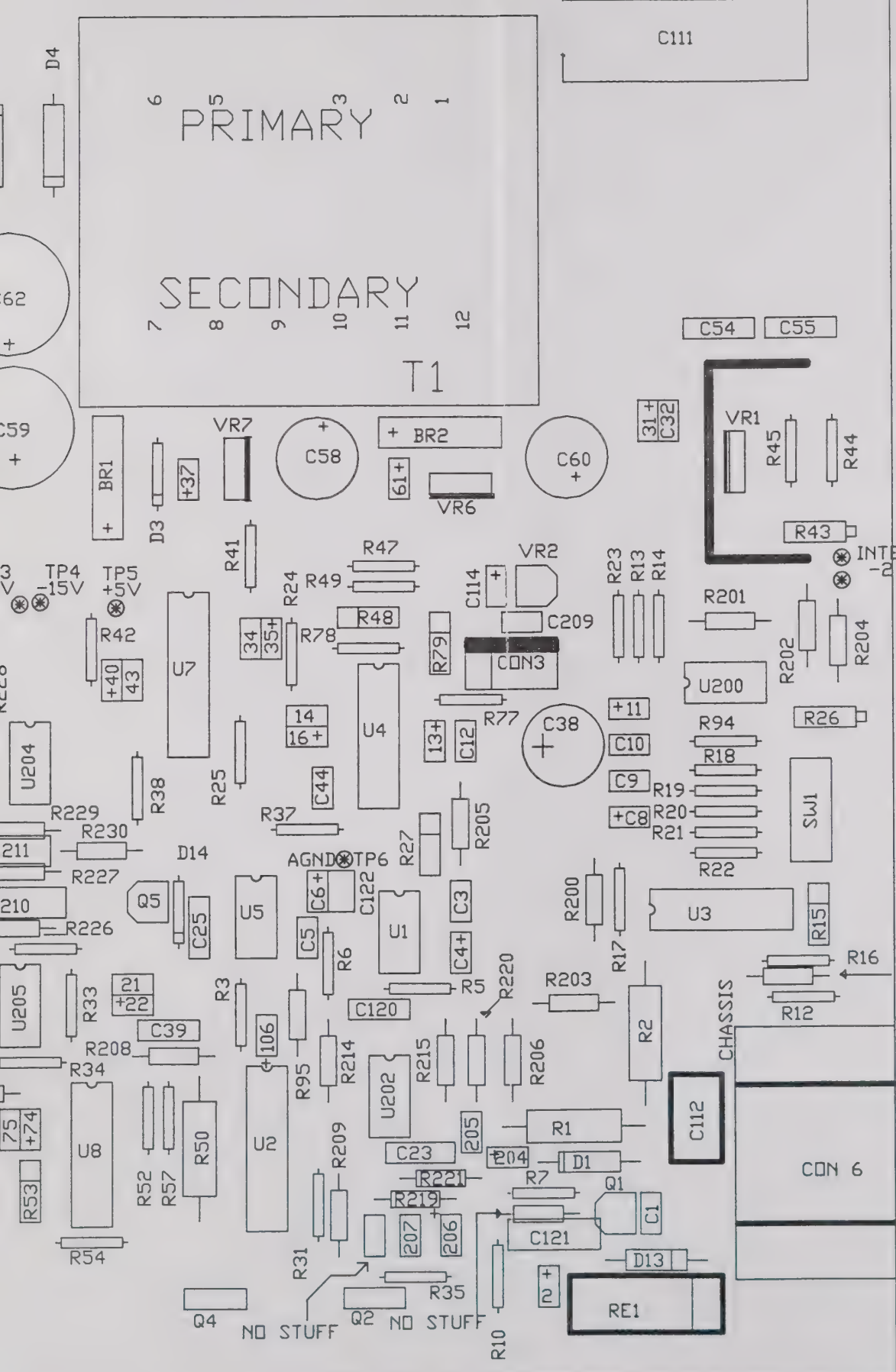
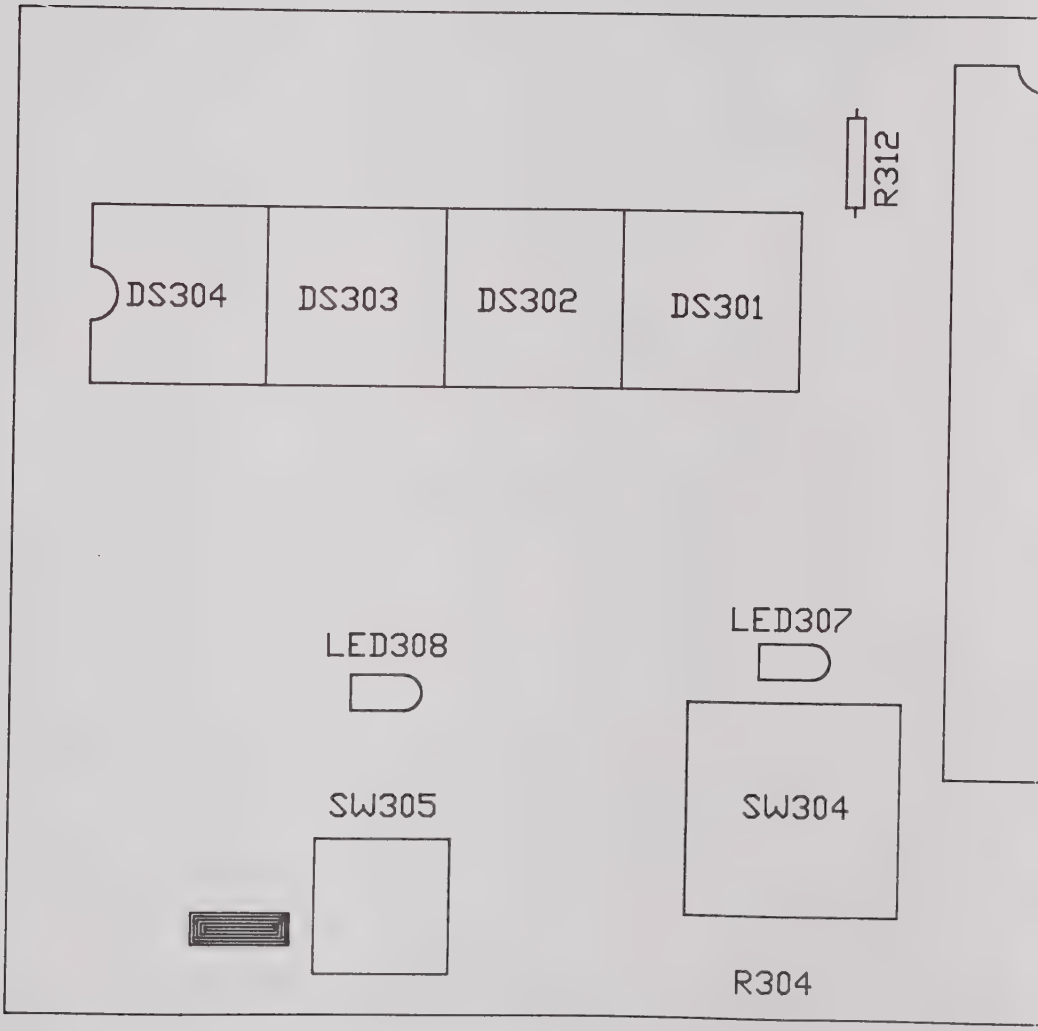


Diagram 7.1 Main Circuit Board Component Layou


R312
DS304
DS303
DS302
DS301
LED308
LED307
SW305
SW304
R304

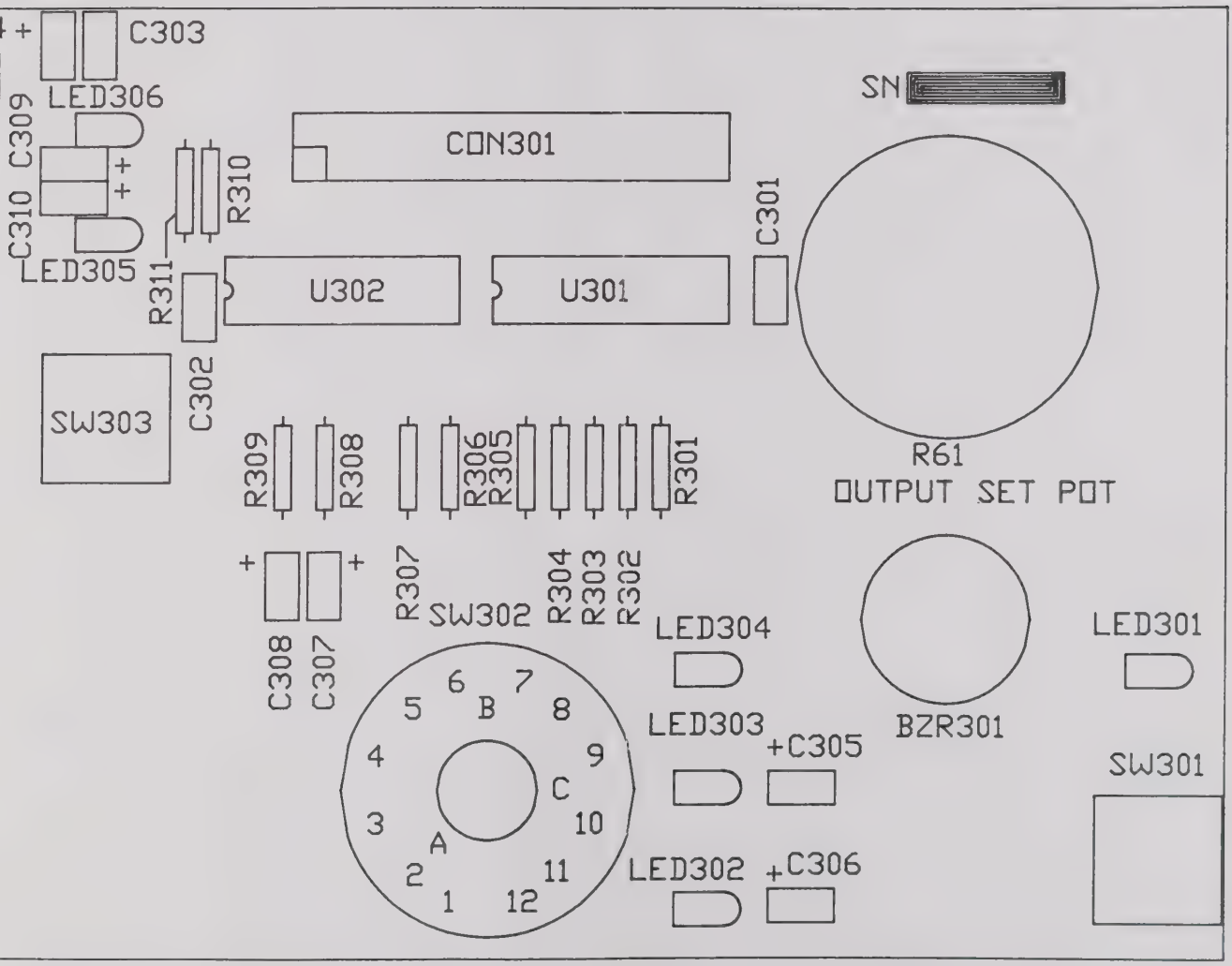
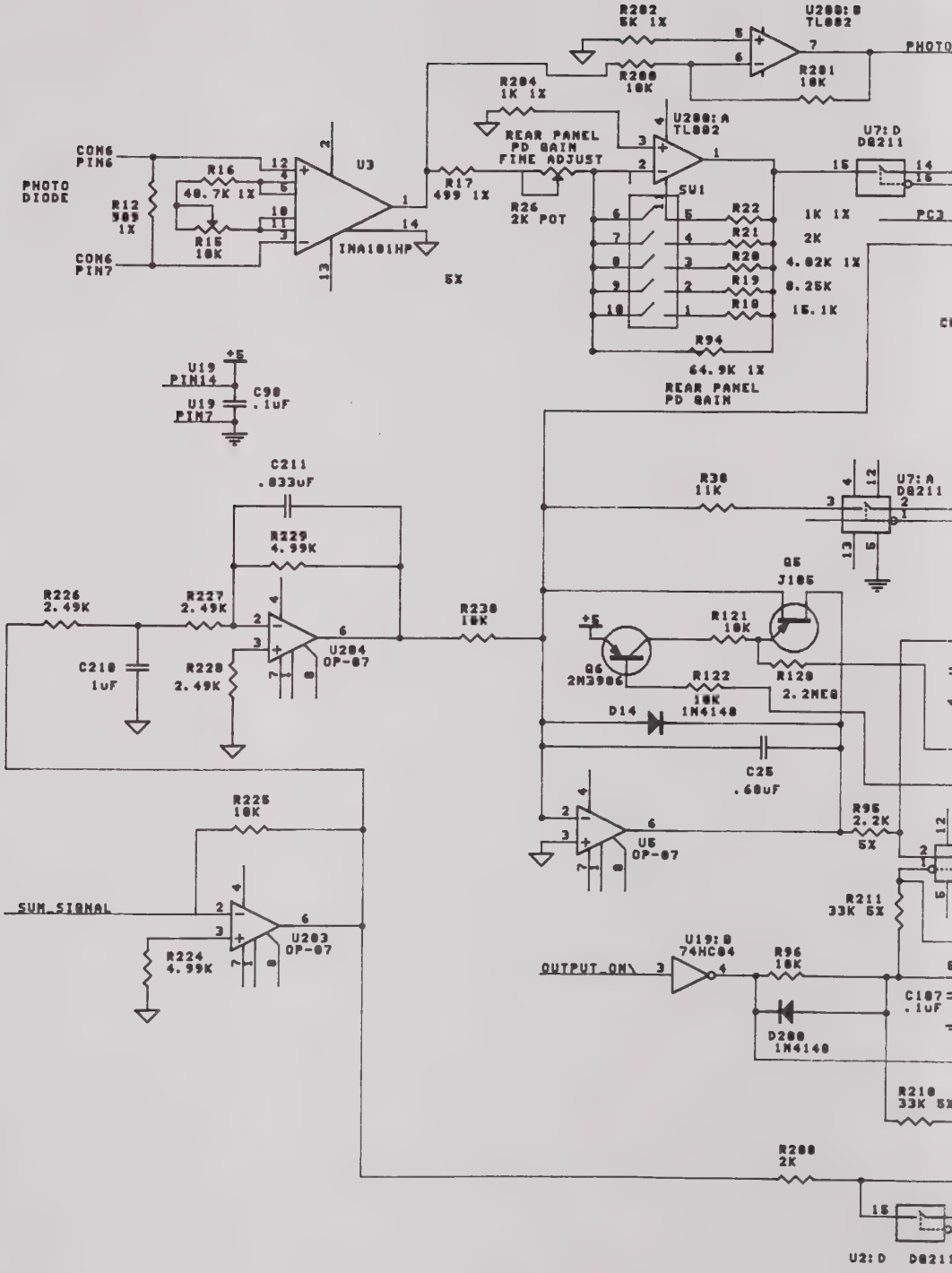


Diagram 7.2 Front Panel Circuit Board Component Layout


R202
5K 1X
U200:B
TL082
PHOTO
R200
10K
R201
10K
R204
1K 1X
U200:A
TL082
REAR PANEL
PD GAIN
FINE ADJUST
U7:D
DG211
CON6
PIN6
PHOTO
DIODE
R16
40.7K 1X
U3
R12
909
1X
R15
10K
CON6
PIN7
R17
499 1X
R26
2K POT
INA101HP
5X
SW1
R22
1K 1X
R21
2K
R20
4.02K 1X
R19
8.25K
R18
15.1K
R94
64.9K 1X
REAR PANEL
PD GAIN
PC3
U19
PIN14
U19
PIN7
C90
.1uF
C211
.033uF
R38
11K
U7:A
DG211
R229
4.99K
Q5
J105
R226
2.49K
R227
2.49K
R230
10K
R121
10K
C218
1uF
R228
2.49K
U204
OP-07
Q6
2N3906
R122
10K
R120
2.2MEG
D14
1N4148
C25
.68uF
R225
10K
U5
OP-07
R95
2.2K
5X
SUM_SIGNAL
U203
OP-07
R224
4.99K
R211
33K 5X
U19:B
74HC04
OUTPUT_ON\
R96
10K
C107
.1uF
D200
1N4148
R210
33K 5X
R208
2K
U2:D
DG211

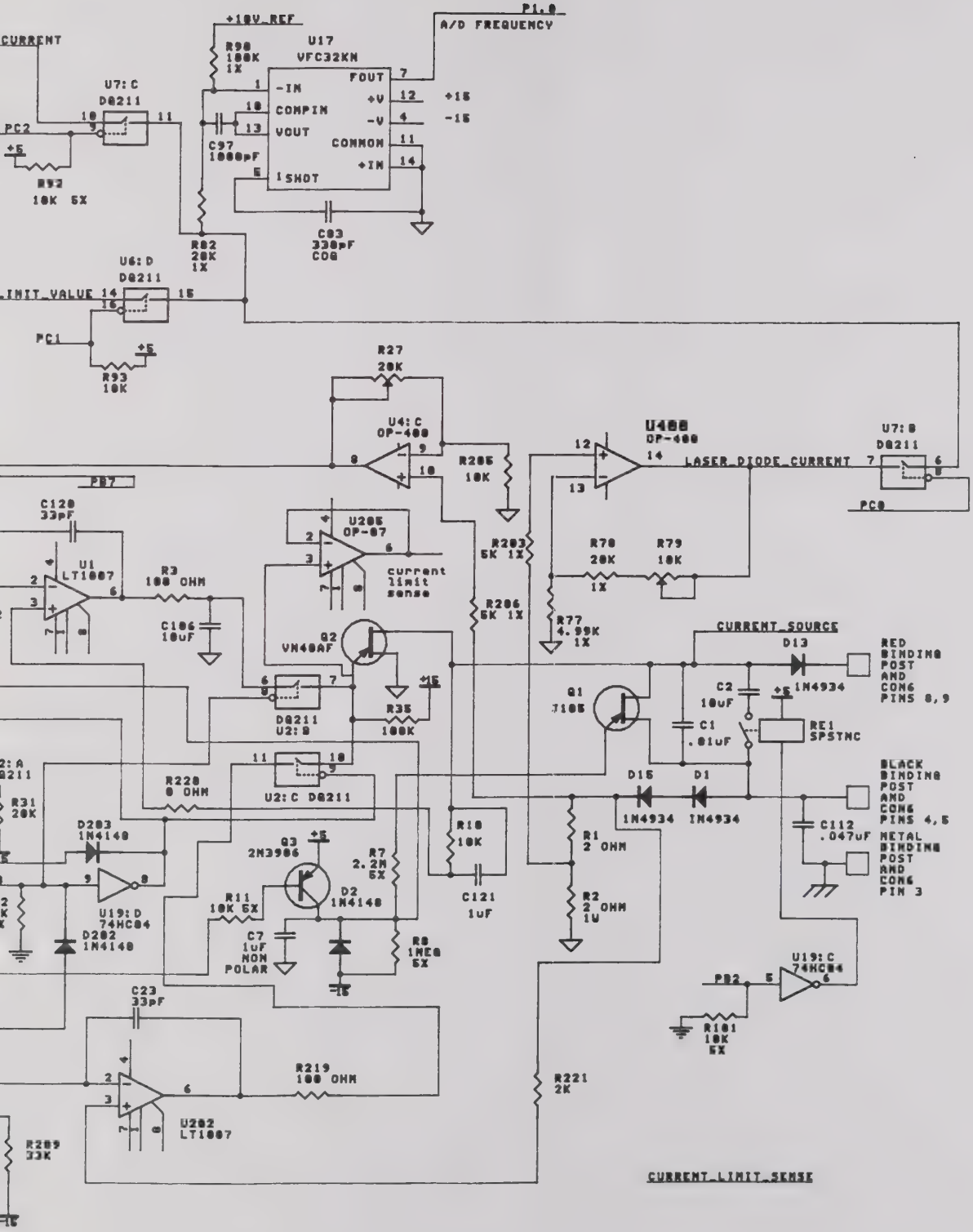
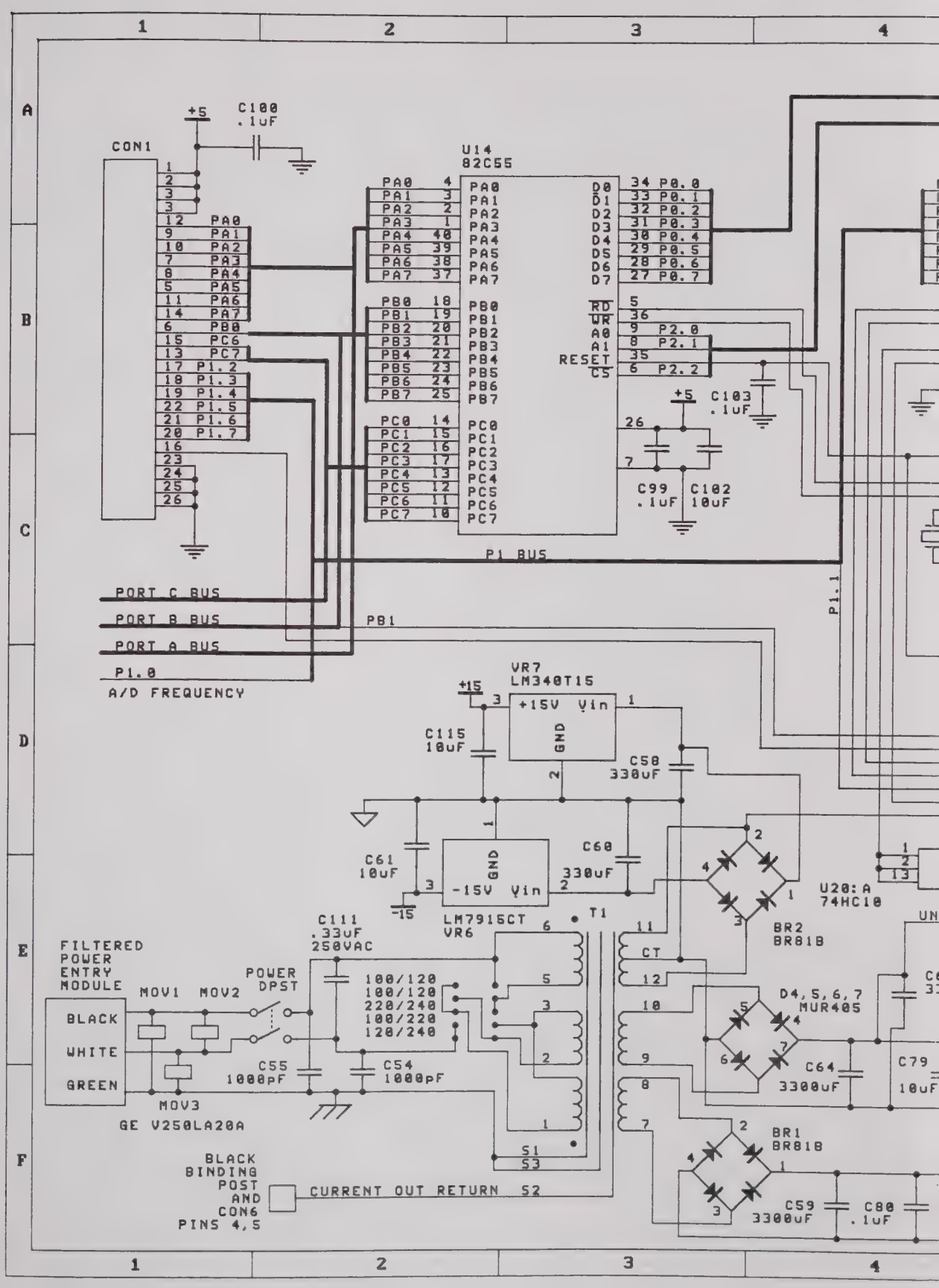


Diagram 7.3 Main Board PD Feedback/Current Output Schematic Diagram


CON1
U14
82C55
+5
C100
.1uF
C103
.1uF
C99
.1uF
C102
10uF
P1 BUS
PORT C BUS
PORT B BUS
PORT A BUS
P1.0
A/D FREQUENCY
PB1
P1.1
VR7
LM340T15
+15V Vin
GND
C115
10uF
C58
330uF
C61
10uF
C60
330uF
-15V Vin
LM7915CT
VR6
-15
T1
U20:A
74HC10
BR2
BR81B
FILTERED
POWER
ENTRY
MODULE
BLACK
WHITE
GREEN
MOV1
MOV2
MOV3
GE V250LA20A
POWER
DPST
C111
.33uF
250VAC
100/120
100/120
220/240
100/220
120/240
C55
1000pF
C54
1000pF
CT
D4,5,6,7
MUR405
C64
3300uF
C79
10uF
BR1
BR81B
C59
3300uF
C80
.1uF
S1
S3
S2
CURRENT OUT RETURN
BLACK
BINDING
POST
AND
CON6
PINS 4,5

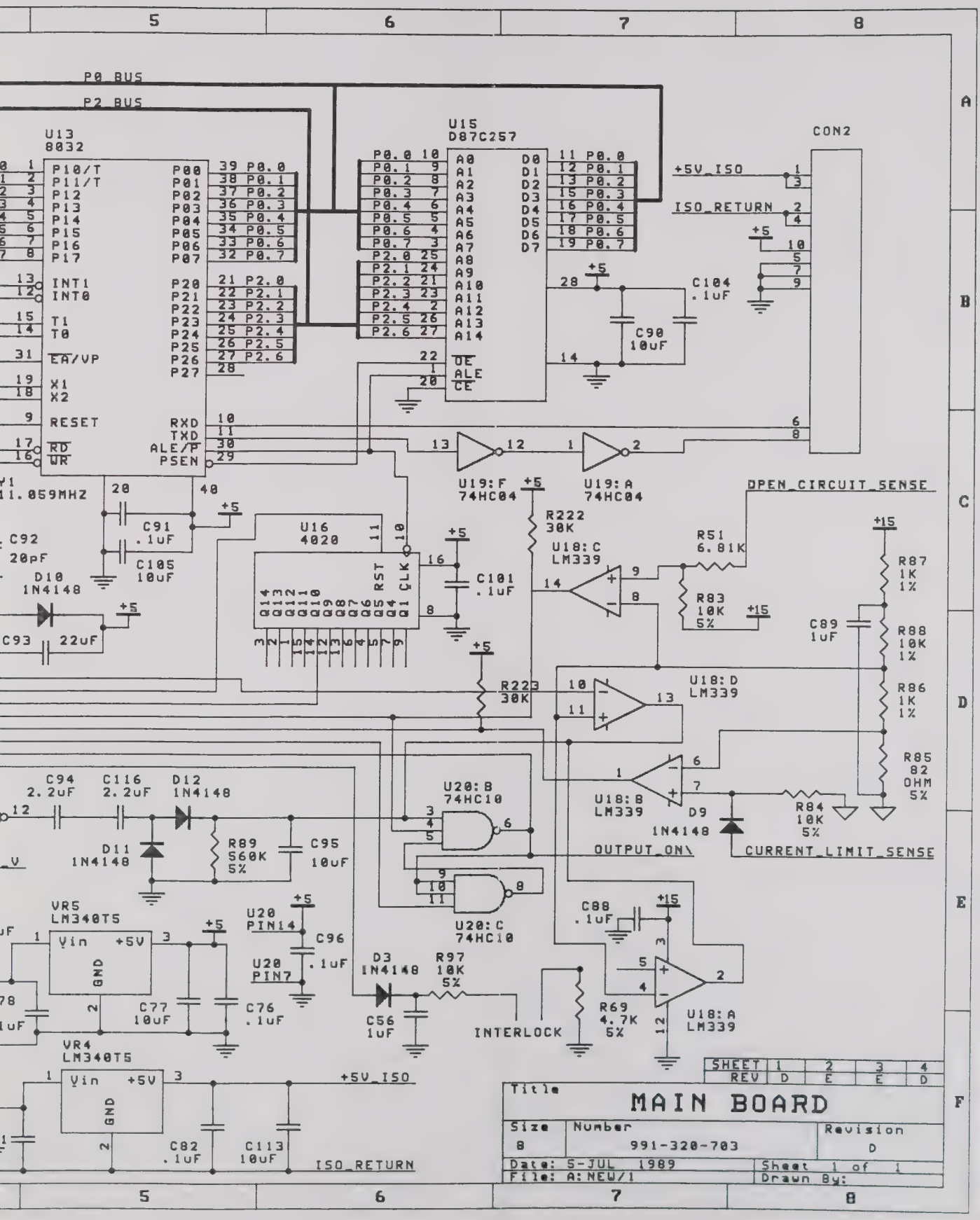
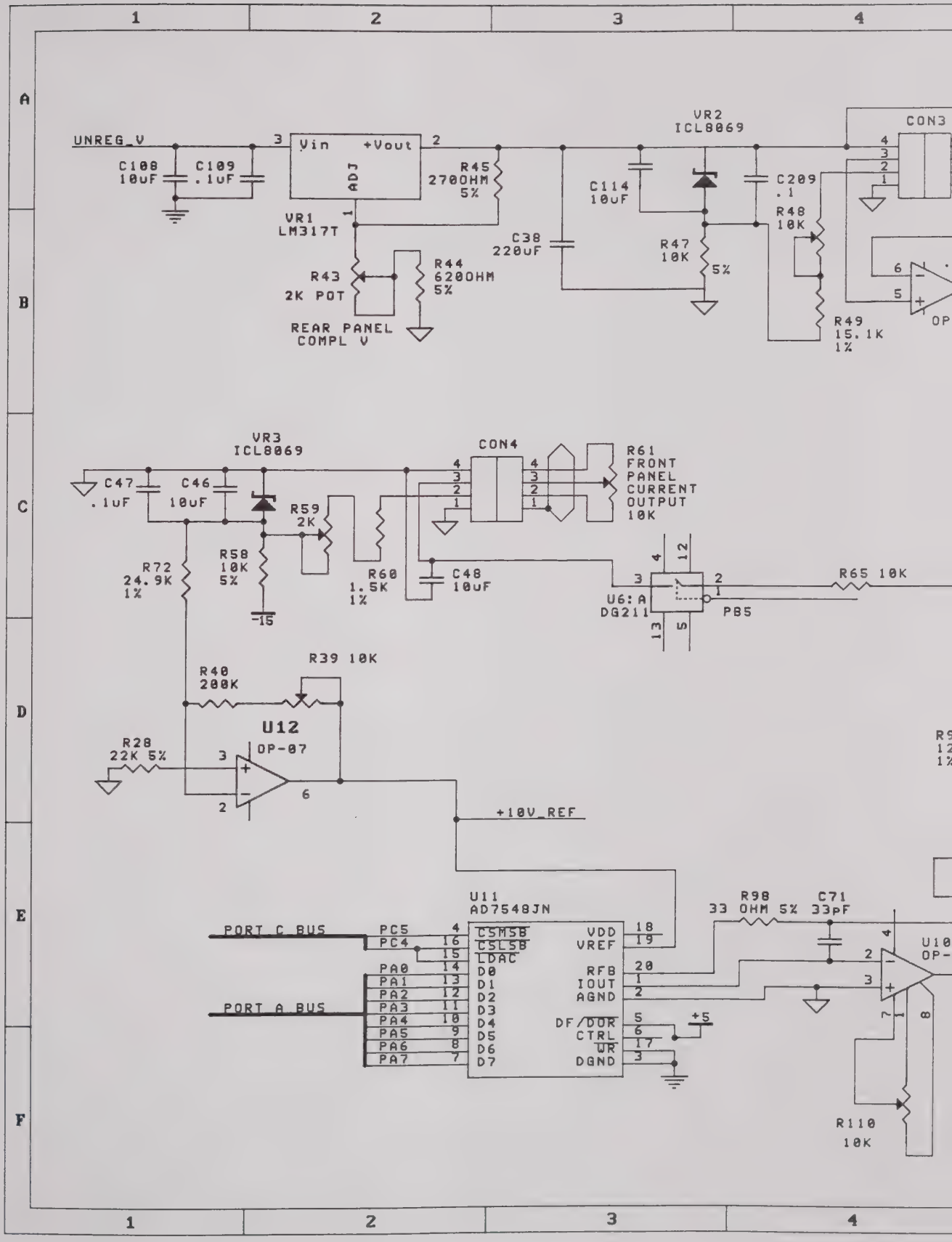


Diagram 7.4 Main Board Digital Section/Power Supplies Schematic Diagra


UNREG_V
C108 10uF
C109 .1uF
Vin
+Vout
ADJ
VR1 LM317T
R45 2700HM 5%
R43 2K POT
R44 6200HM 5%
REAR PANEL COMPL V
C38 220uF
VR2 ICL8069
C114 10uF
R47 10K 5%
C209 .1
R48 10K
R49 15.1K 1%
CON3
OP
VR3 ICL8069
C47 .1uF
C46 10uF
R59 2K
R58 10K 5%
R72 24.9K 1%
R60 1.5K 1%
C48 10uF
CON4
R61 FRONT PANEL CURRENT OUTPUT 10K
U6:A DG211
PB5
R65 10K
R40 200K
R39 10K
U12
OP-07
R28 22K 5%
+10V_REF
U11 AD7548JN
PORT_C_BUS
PORT_A_BUS
PC5
PC4
PA0
PA1
PA2
PA3
PA4
PA5
PA6
PA7
CSMSB
CSLSB
LDAC
D0
D1
D2
D3
D4
D5
D6
D7
VDD
VREF
RFB
IOUT
AGND
DF/DDR
CTRL
WR
DGND
+5
R98 33 OHM 5%
C71 33pF
R110 10K

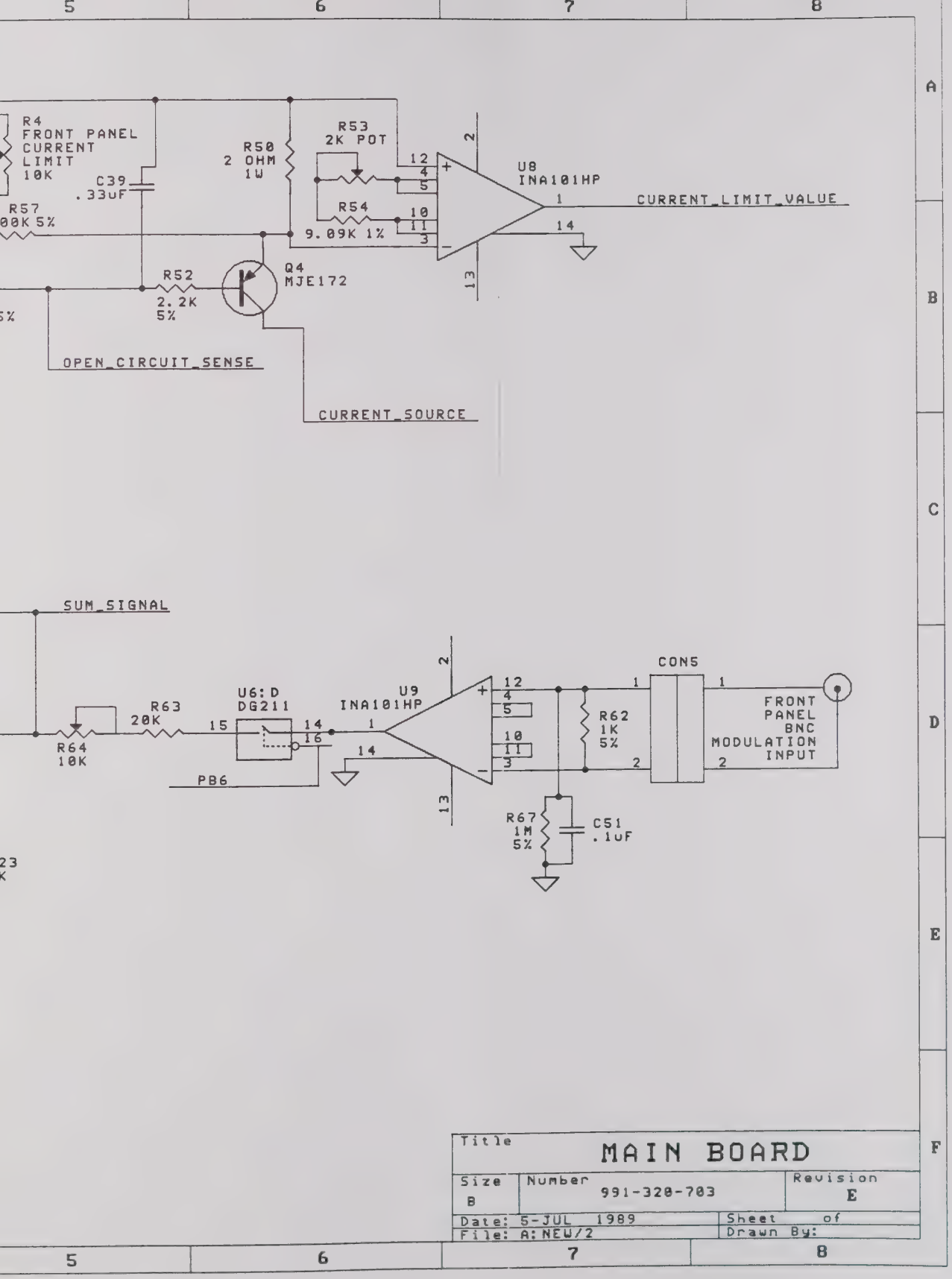
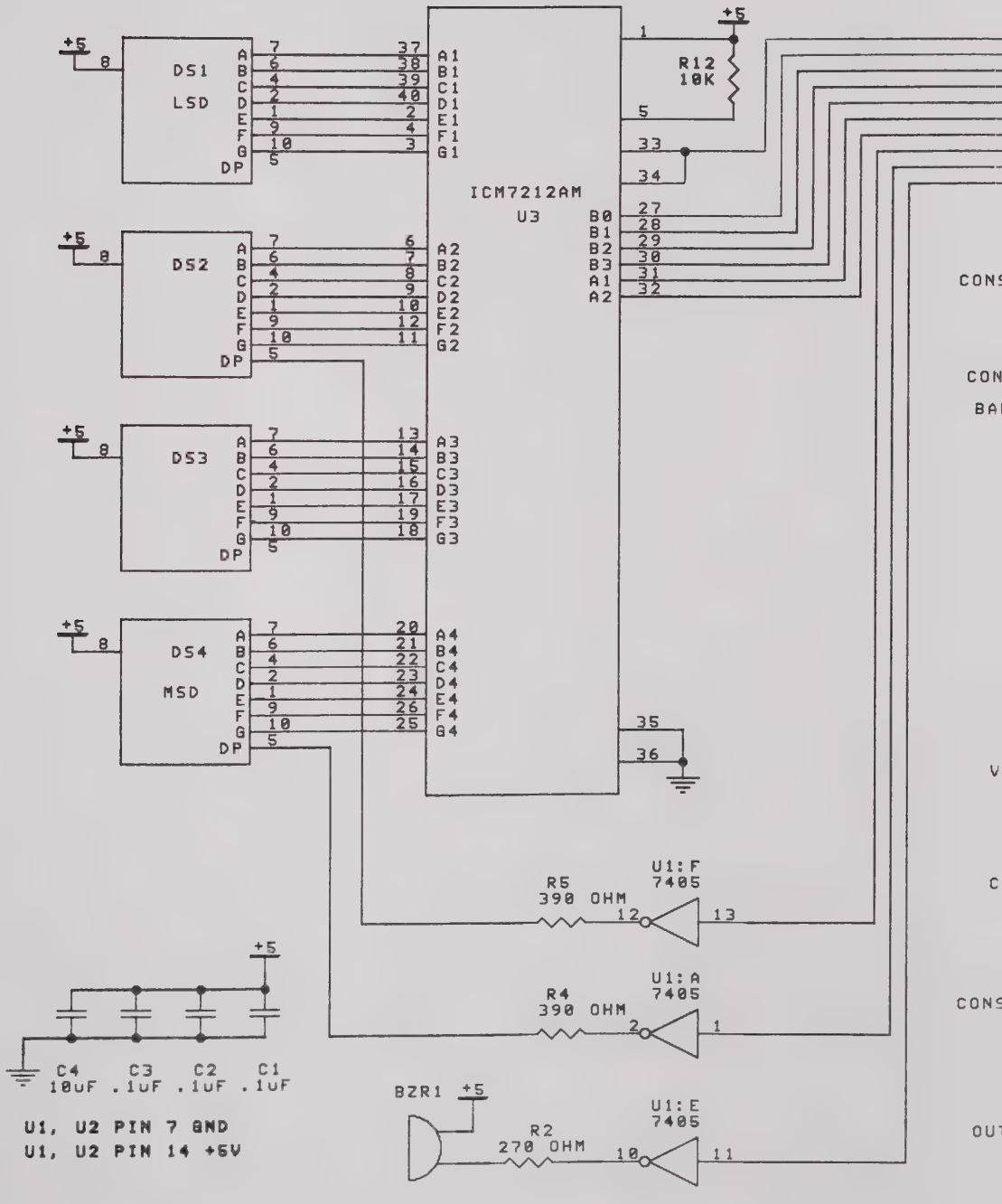


Diagram 7.5 Main Board Current Limit/MOD Input Schematic Diagram


DS1
LSD
DS2
DS3
DS4
MSD
ICM7212AM
U3
R12
10K
R5
390 OHM
R4
390 OHM
R2
270 OHM
U1:F
7405
U1:A
7405
U1:E
7405
BZR1
C4
10uF
C3
.1uF
C2
.1uF
C1
.1uF
U1, U2 PIN 7 GND
U1, U2 PIN 14 +5V

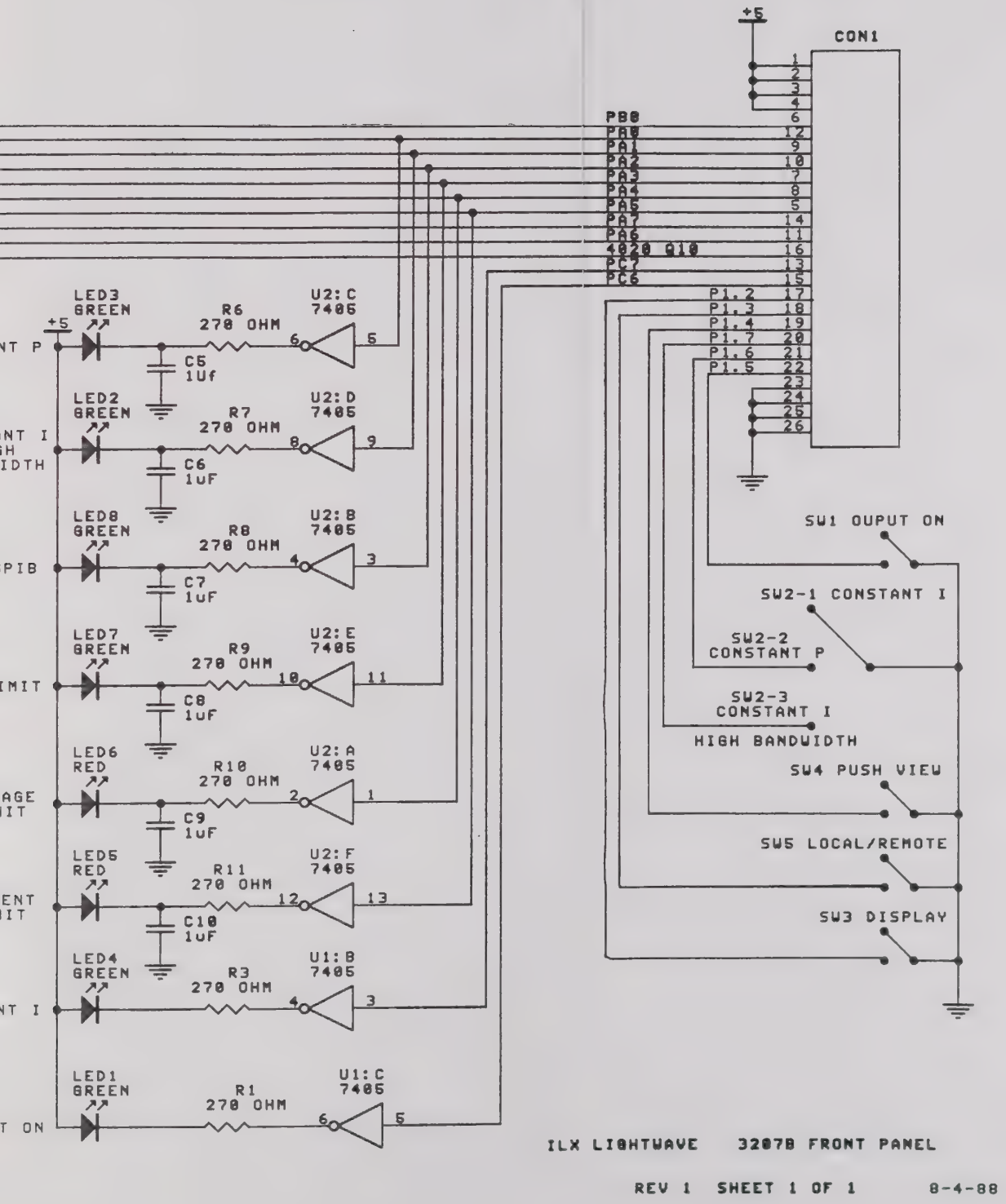
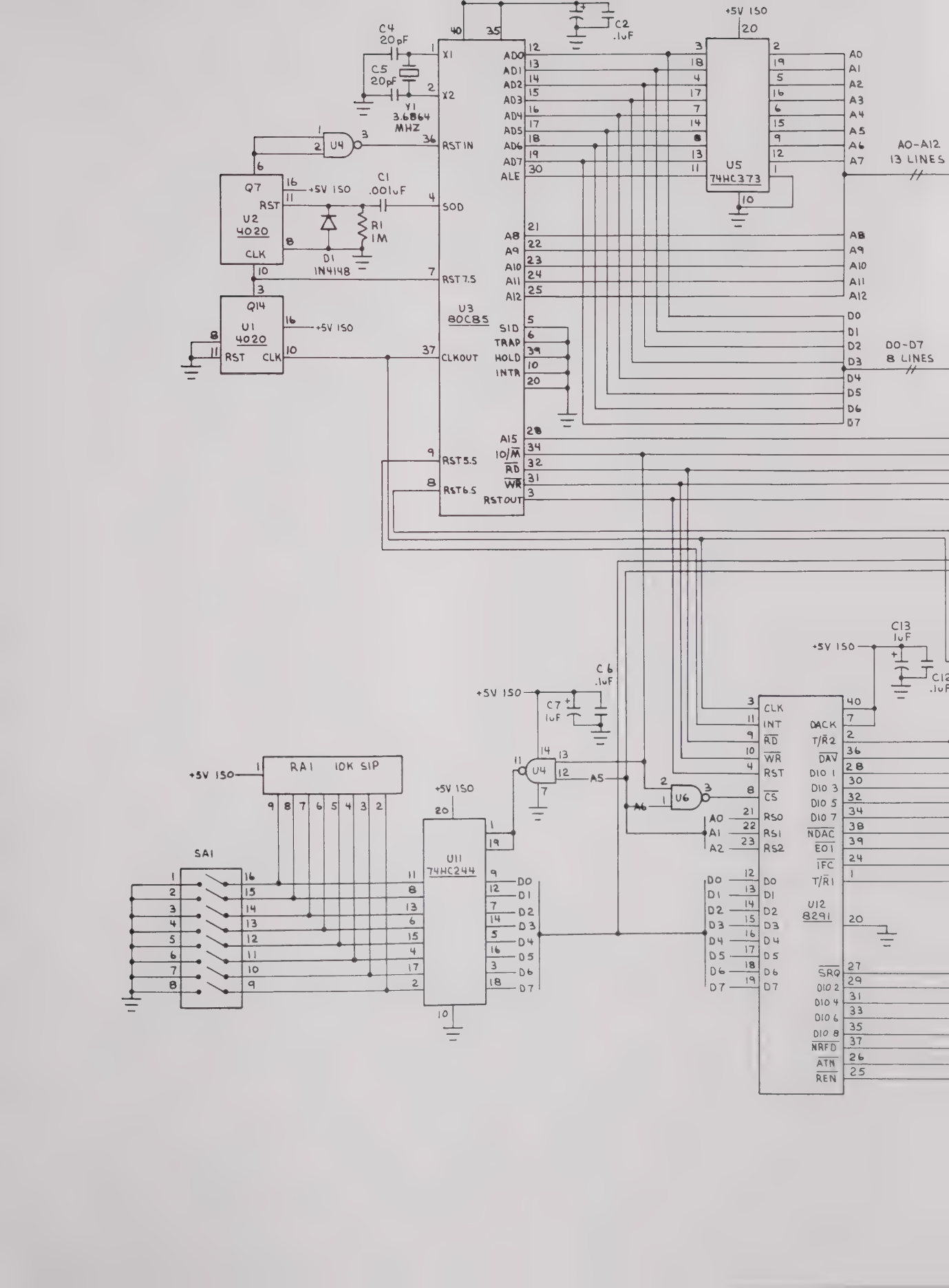


Diagram 7.6 Front Panel Circuit Board Schematic Diagram


C4
20pF
C5
20pF
Y1
3.6864
MHZ
C2
.1uF
+5V ISO
U4
Q7
U2
4020
RST
CLK
C1
.001uF
R1
1M
D1
1N4148
Q14
U1
4020
U3
80C85
RST IN
SOD
RST7.5
CLKOUT
RST5.5
RST6.5
RSTOUT
SID
TRAP
HOLD
INTR
AD0
AD1
AD2
AD3
AD4
AD5
AD6
AD7
ALE
A8
A9
A10
A11
A12
A15
10/M
RD
WR
U5
74HC373
A0-A12
13 LINES
D0-D7
8 LINES
C13
1uF
C12
.1uF
C6
.1uF
C7
1uF
RA1
10K SIP
SA1
U11
74HC244
U6
U12
8291
CLK
INT
RD
WR
RST
CS
RS0
RS1
RS2
DACK
T/R2
DAV
DIO 1
DIO 3
DIO 5
DIO 7
NDAC
EOI
IFC
T/R1
SRQ
DIO 2
DIO 4
DIO 6
DIO 8
NRFD
ATN
REN

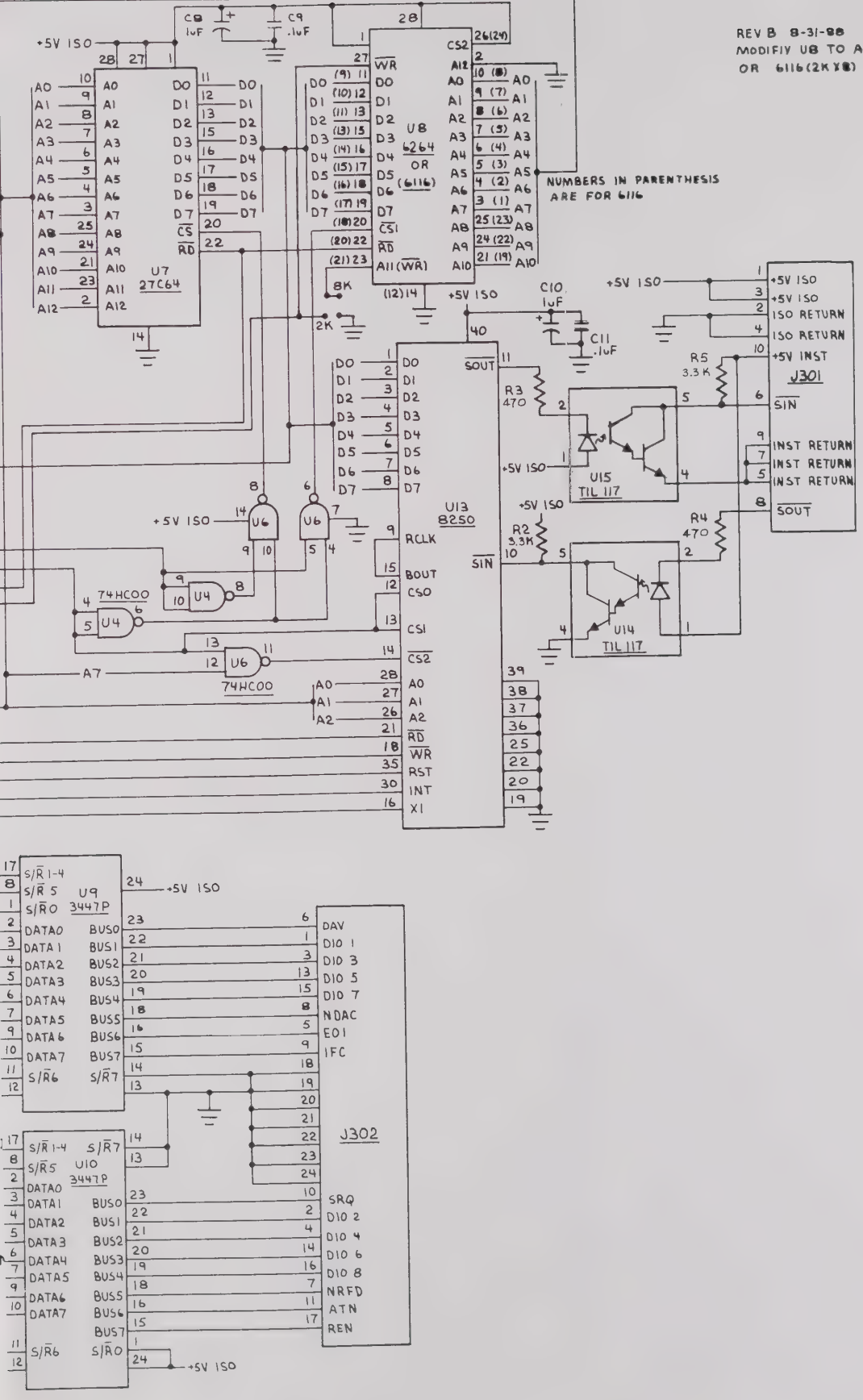
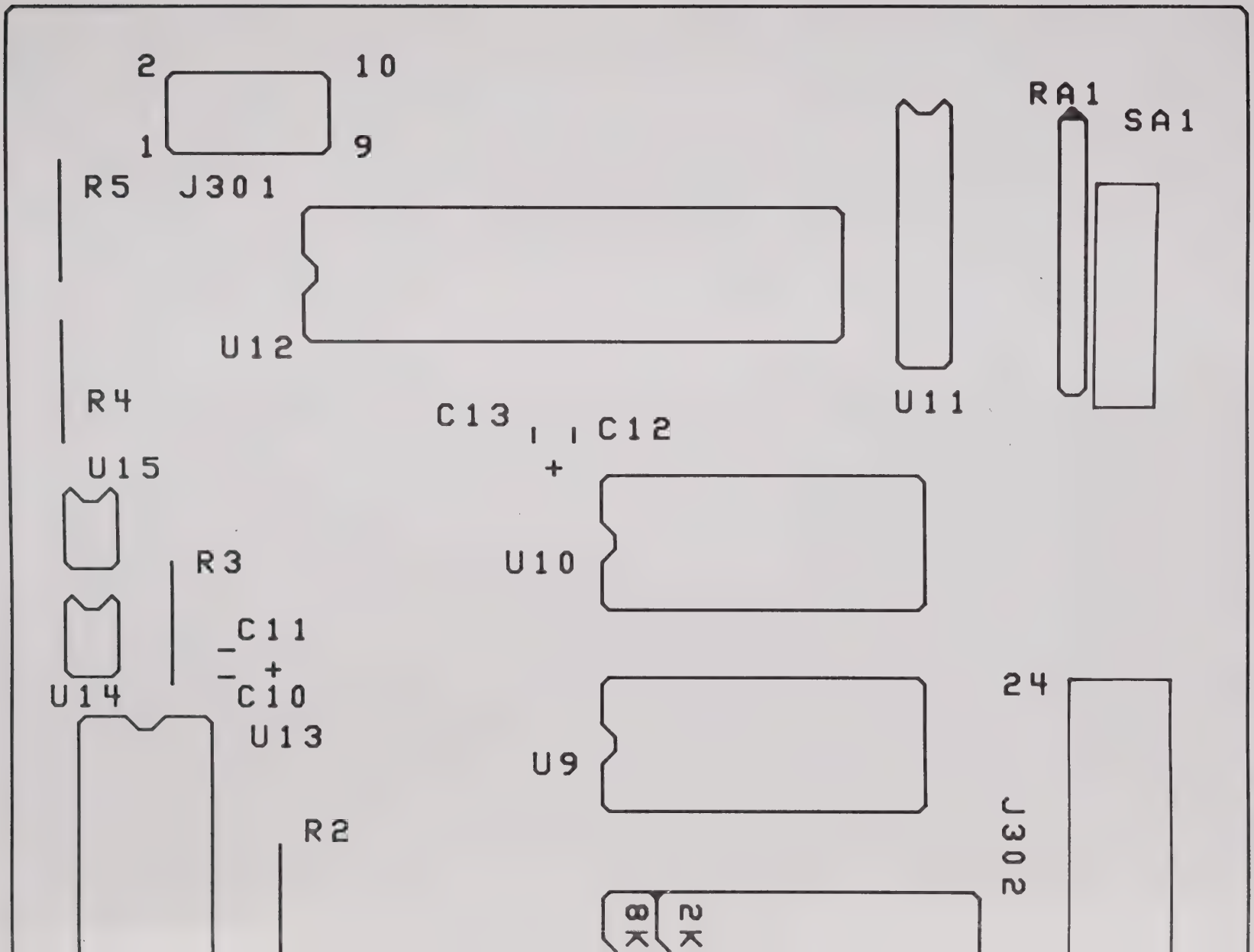


Diagram 7.7 Model 1227 GPIB/IEEE-488 Schematic Diagram


2
10
1
9
J301
R5
R4
U12
U11
RA1
SA1
C13
C12
+
U15
U10
R3
C11
+
U14
C10
U13
U9
24
J302
R2
8K
2K

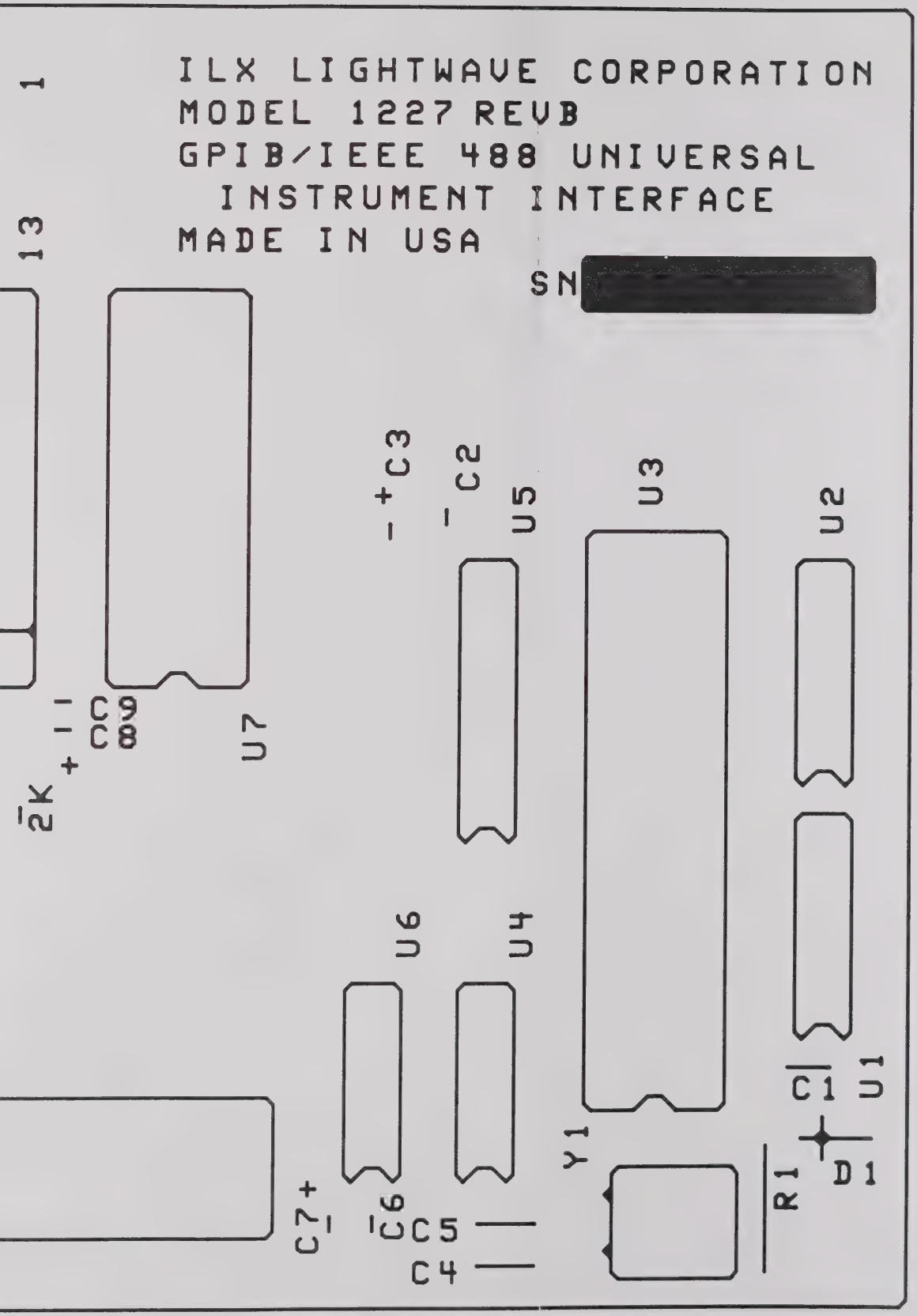
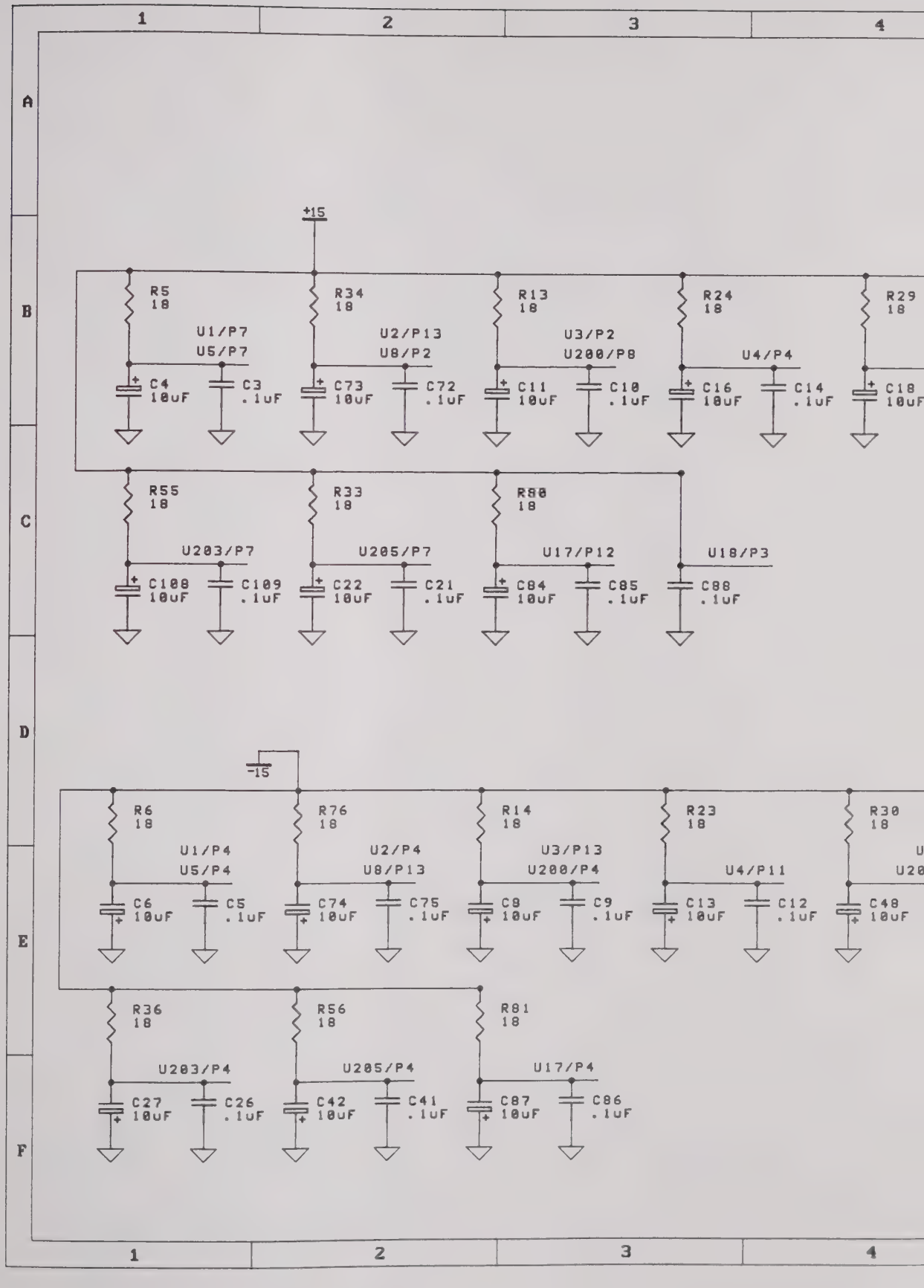


Diagram 7.8 Model 1227 GPIB/IEEE-488 Component Layout


1
2
3
4
A
B
C
D
E
F
+15
R5
18
U1/P7
U5/P7
C4
10uF
C3
.1uF
R34
18
U2/P13
U8/P2
C73
10uF
C72
.1uF
R13
18
U3/P2
U200/P8
C11
10uF
C10
.1uF
R24
18
U4/P4
C16
10uF
C14
.1uF
R29
18
C18
10uF
R55
18
U203/P7
C108
10uF
C109
.1uF
R33
18
U205/P7
C22
10uF
C21
.1uF
R88
18
U17/P12
C84
10uF
C85
.1uF
U18/P3
C88
.1uF
-15
R6
18
U1/P4
U5/P4
C6
10uF
C5
.1uF
R76
18
U2/P4
U8/P13
C74
10uF
C75
.1uF
R14
18
U3/P13
U200/P4
C8
10uF
C9
.1uF
R23
18
U4/P11
C13
10uF
C12
.1uF
R30
18
C48
10uF
R36
18
U203/P4
C27
10uF
C26
.1uF
R56
18
U205/P4
C42
10uF
C41
.1uF
R81
18
U17/P4
C87
10uF
C86
.1uF

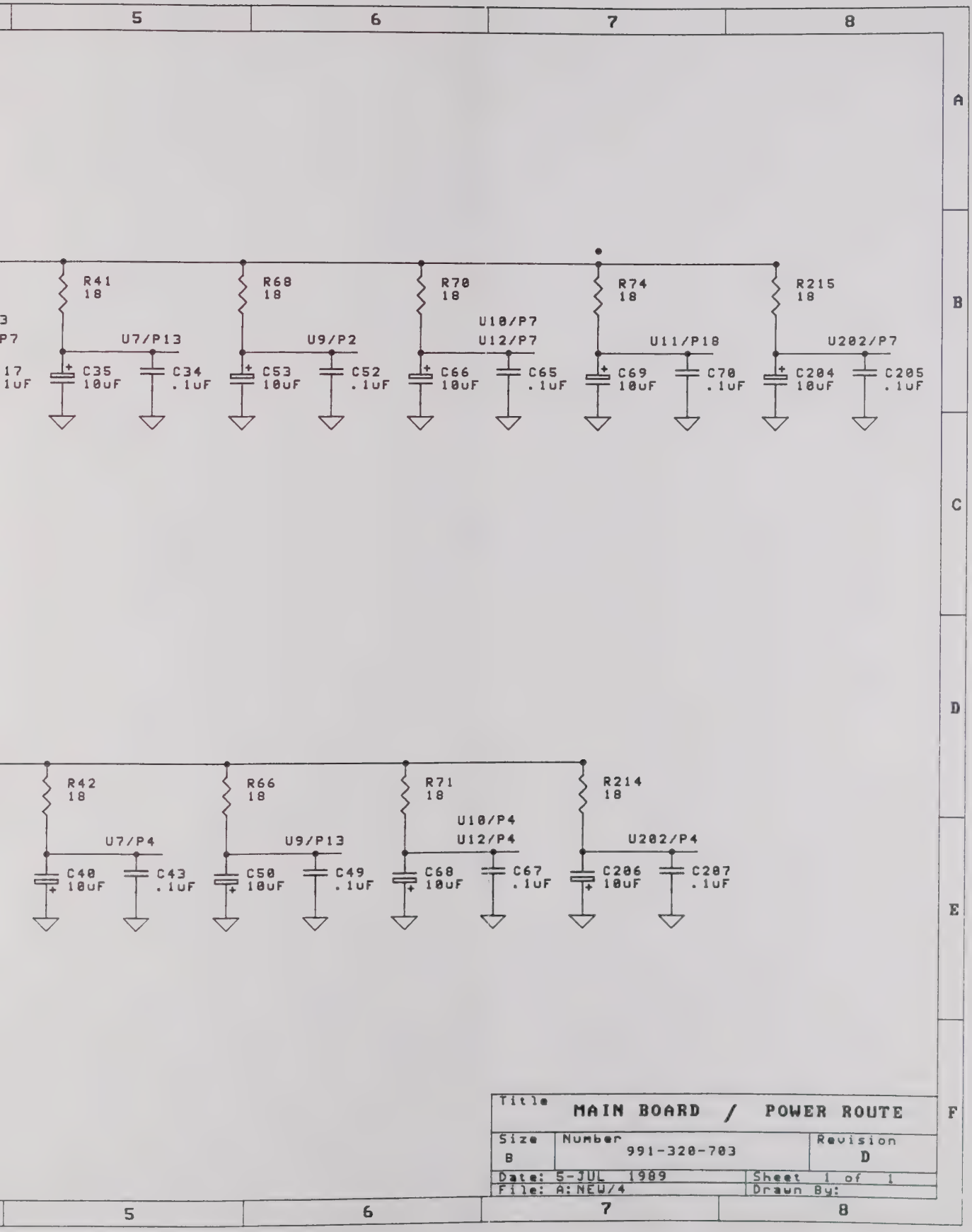


Diagram 7.9 3207B Power Route Schematic Diagra

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